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ACCIDENTS TO FLY WHEELS.

The letter of Mr. T. C. Coykendall which we print elsewhere, advances an explanation for accidents to fly wheels in power houses which is rather novel. The usual cause assigned for such accidents is an increase of speed when the load is thrown off, due to an improperly designed or defective governor. The one offered by Mr. Coykendall is practically the reverse of this, as he ascribes the destructive strain to the load suddenly put on the engine when a circuit breaker, opened by an overload, is again thrown in. In the first case the damage is held to be due to centrifugal action on the wheel, and in the second case to the sudden shock to which it is subjected. As Mr. Coykendall states that several recent accidents to fly wheels which he has investigated can be more readily accounted for on the second assumption than on the first, the matter is one well worth looking into, and we shall be glad to publish the opinions of engineers on the subject.

ELECTRO-CHEMISTRY.

The increasing extent to which electricity is being applied in chemical operations, particularly in Germany, calls attention to the importance of this branch. In the country named and in France, this branch of electrical science is held in high esteem as promising the best field for profitable working, and during the last year or more a number of electro-chemical processes of value have been developed. Among these is the Hermite disinfecting process, which appears to be identical with that now employed by the New York City Government at Rikers Island and elsewhere, and the Digest of this week refers to the electrolytic production of soda, potassic chlorate, sulphuric acid and bleaching material, and to an electrolytic process for the purification of dyes. Those who have followed this section of the Digest will have noted the evidence of the progress in Europe we have referred to, and in which we hope our own country will in the future participate more than it has done in the past.

OVER-COMPOUNDING DYNAMOS IN PARALLEL.

In another column Prof. E. P. Roberts calls attention to a case of over-compounding, where, instead of securing the regulation of voltage desired, the reverse is the case. If two or more dynamos are connected in parallel and each compounded as usual for a certain line loss, the regulation of voltage aimed at will only be attained when all of the machines are kept in circuit. For if the load becomes light and one or more be disconnected, then those still left in circuit will over-compound, not for the current on the line, but for the current in their armatures. If only one machine is left, for instance, and it is heavily loaded, the increase in voltage may be a maximum when it might happen that the load on the line is a minimum, thus subjecting lamps to an abnormal voltage. Two methods are pointed out by means of which this fault may be obviated; one consists in having a multiplicity of exterior circuits independent of each other, which seems to be impracticable; the other necessitates the use of rheostats in the shunt circuit, or, in other words, a double waste of energy, or in both the series coil and in the rheostat. Neither of these methods is satisfactory, and it would seem that in the case considered the best solution would consist in the employment of plain shunt dynamos if there is a large and gradual variation in load.

THE MANAGEMENT OF POWER STATIONS.

The article by Mr. George T. Hanchett under the above caption, now appearing in our columns, will be found to contain information of a decidedly practical character relating to the management of the steam plant of both lighting and power stations. While more and more attention is being paid to the steam department of electri-

cal generating stations, yet the importance of the economies that may be there attained will continue to amply repay the most careful study of the subject. The home-made steam separator illustrated is so cheaply constructed that there can be no excuse left for the station manager to be without this useful adjunct if he has hesitated heretofore on the score of expense. It should be borne in mind that the function of a separator is not only to prevent water from damaging an engine by ''pounding'' but that it will also effect an economy in the working of the steam in the cylinder. Feed-water heaters are comparatively so inexpensive and the saving to be effected by their use so considerable, that it would be poor economy to rest content with a home-made form like that shown, though even such a makeshift will be much better than none. The lines pointed out in the articles along which possible saving may be made would doubtless, if applied in not a few stations, result in a surprising increaee in income and certainly in a much more satisfactory state of affairs to all concerned.

SYMBOLS AND ABREVIATIONS.

A criticism by Prof. Jamieson, abstracted in the Digest, on the table of ''Symbols for Physical Quantities and Abbreviations for Units'' printed in the Electrical World, of August 25, is strongly confirmative of the wisdom of the Notation Committee of the Chicago International Electrical Congress, which gave approval to it; for if an unfriendly critic with a rival system can say nothing more damaging we may accept the conclusions embodied in the table to be indeed strongly based. It is true that the system criticized is not theoretically perfect from every point of view, but the aim was not to secure such perfection, which, besides, would have been impossible, but to compile a table that would most probably meet with international acceptance. The criterion to be applie d is not, therefore, that of personal opinion; if we are to have an international system we must be willing to meet international views and even make sacrifice to what we may consider unwarranted usages, but yet too firmly fixed to be changed. It is singular that the criticism applied to the use of script letters for magnetic quantities is precisely the one which led to their adoption, which was that they were much more readily written than the bold faced gothic; it was not intended that the exact form of the letter be copied in writing any more than that other script letters are thus imitated. It was supposed that a writer would merely employ the usual script capital, and, to guide the printer, add the necessary direction in the margin in the same way that Greek letters are designated. The use of L_s and L_m for self and mutual-inductance, it may be remarked, though not indicated in the table, is not at variance with its plan.

REACTANCE.

The section of Prof. Ryan's article on ''Alternate Current Working'' in this issue and that which will appear in the succeeding one, will be found of particular interest on account of the very clear manner in which the effects of reactance are explained with reference to practical examples. Of all the electrical words adopted in recent years, this is one of the most useful, for it enables the student to grasp an important conception which, if nameless, would offer more than usual difficulties. The sense in which Prof. Ryan uses the word is that given by those who proposed its use, and in this connection we may note that Prof. Blondel, in the current issue of *L'Industrie Electrique*, vigorously protests against an extension which has been offered to its meaning. In a paper by Messrs. Steinmetz and Bedell, in the Transactions of the American Institute of Electrical Engineers, reactance is defined as equal to the impressed E. M. F. at right angles to the current divided by the current; its application, however, is much extended, in the case of a transformer, for example, to the effect of that part of the back E. M. F., due to the influence of the secondary upon the primary, which is in quadrature with the component in the same direction as the current. Prof. Blondel severely criticises this extension, for, according to it, he says, reactance is no longer a constant of a circuit, but a complex amalgam of all sorts of reactions, leading in some cases to an absurd complication. He concludes that reactance ought, like all other words ending in *ance*, be used only to define a constant of a circuit, and, therefore, should only apply to the effects of inductance and capacity in a circuit. The ground of Prof. Blondel seems to be well taken, and moreover, the sense in which the word was adopted by the American Institute of Electrical Engineers is that which he approves, and does not, therefore, include the extensions referred to and criticised. It is well that this should be understood, for otherwise a most useful term might fall under unwarranted suspicion.

First Aid in Electric Accidents.

Dr. W. S. Hedley in a letter to the London ''Lancet,'' reprinted in the London ''Electrical Engineer,'' gives some rules as to the first aid to be rendered in case of electric accidents, as follows:

(1) Break the circuit at once if there be an interrupter close at hand and you know how to use it; if not, lose no time, but proceed to Rule 2. (2) Do not touch the man's body with your bare hands, but if india rubber gloves are not at hand, pull him off the cable by his coat tail, or fold your coat or some such dry article into two or three thicknesses, and, using this as a pad to take hold of the body, pull it away from the circuit and resort to Rule 5. (3) If unable to get him off, raise with covered hands that part of the body which is touching the earth, or one of the poles of the circuit. This will break the circuit, and it will usually be thus possible to get him easily away, and, if so, proceed to Rule 5. (4) If still unsuccessful, make another pad, and, placing it between the ground and that part of the body in contact with the ground, continue your efforts to detach him. (5) Having pulled him away from the cable, free his neck from clothing, and treat the case as one of drowning, one method being as follows: (6) Open his mouth, and, taking hold of the front part of the tongue with your fingers—covered with a handkerchief if you have one—draw the tongue forward, and gradually let it go back 16 times a minute. Be sure that the root of the tongue is acted upon and drawn forward. If the teeth are clenched and you cannot get them apart with your fingers, gently separate them with the handle of a pocket-knife or by a small piece of wood, cork, etc. (7) Resist the efforts of the bystanders to pour stimulants down his throat until a medical man arrives and ''takes over'' the case.

New Rule for Current and Lines of Force.

Mr. C. E. Goodrich, in referring to the rule given on page 255 of the Electrical World, April 7th, suggests the following, which he considers better: ''The sun appears to travel from east to west and the direction of the current and lines of force is the same.'' The choice of the best of a large number of rules is to a great extent a matter of taste; each has its disadvantages. For instance, if we understand him correctly, we must imagine the sun as moving some distance below the surface of the earth; then the lines of force observed on the earth (and which must be supposed to return through its axis, thus encircling the current) have the same direction as if the apparent motion ot the sun were a current. But, if we imagine the sun above us, where it really is, the direction will be wrong. Furthermore, we must remember that the geographical north pole of the earth would, in a laboratory, be marked the south pole, but if we limit ourselves to the direction of a compass needle, this discrepancy need not trouble us, provided we forget all about the geographical north pole and consider only the lines of force around us.

A Simple Rule.

A very simple rule, which may be new to some, for remembering the relative directions of the lines of force encircling a wire and the current producing them, is as follows:

If the circular direction of motion of a nut on a bolt represents the lines of force around the bolt, then the direction of the current which produces them will be that in which the nut travels along the bolt, assuming, of course, the usual right-handed screw thread.

A Wise Admission.

There is a very true saying to the effect that the more a man knows the more he knows how little he knows, which applies to a recent remark in our esteemed London contemporary "The Electrician." In referring to the expression "in contact with electricity" used by a correspondent, the editorial adds "we know nothing about 'electricity'; the word is very rarely used except by accident in the editorial columns of 'The Electrician.'"

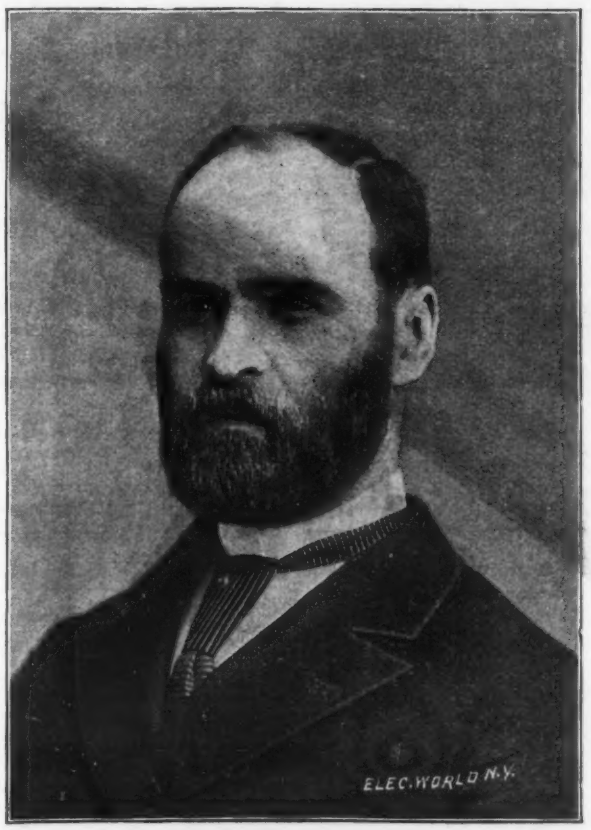
Alexander Macfarlane.

Alexander Macfarlane was born at Blairgowrie, Scotland, April 21st, 1851. He was educated at the public school, where at the age of 13, he became a pupil-teacher. At 18, having finished his apprenticeship as a teacher and saved a little money, he entered the University of Edinburgh. There he first distinguished himself in the study of the classics, and by his eminence in that line won money-prizes sufficient to carry him through an extensive undergraduate course. Though he was urged to study for honors in classics, he preferred to devote special attention to logic and philosophy; but becoming convinced that logic needed an infusion of mathematical and scientific ideas, he took up the study of mathematics and physics with the desire to gain a clear knowledge of their principles.

In 1875 he graduated master of arts with the highest honors in mathematics and physics, and was immediately appointed an instructor in physics by Professor Tait. With the advice and encouragement of that celebrated physicist he made a quantitative investigation of the conditions governing the electric spark, and at the same time pursued the necessary studies for the degree of Doctor of Science in Physics and Mathematics. He obtained that degree in 1878 and was immediately elected a Fellow of the Royal Society of Edinburgh.

His electrical researches came under the notice of Clerk Maxwell, who made suggestions for their extension. He next (1879) published his views on logic in a volume entitled "Principles of the Algebra of Logic," which with subsequent papers on the "Analysis of Relationship" have taken a permanent place in the history of the science. In 1881 he was appointed Mathematical Examiner at the University of Edinburgh; while holding that appointment he prepared the volume on "Physical Arithmetic" (1885) the express object of which is to elucidate the logical processes involved in the application of arithmetic to physical problems.

In 1885 he was called to the chair of physics in the University of Texas, which position he has recently resigned. During the nine years spent there he built up a fine physical department, and accomplished a large amount of research work, for this purpose spending his vacations at the great universities of the North. He prepared an extensive series of mathematical tables on a uniform plan (1889), he added to the research on the electric discharge, and after long reading and study published his views on the subject of space-analysis In carrying out this research he devised a series of models, the earlier specimens of which received an award at the Columbian Exposition.



ALEXANDER MACFARLANE.

In 1887 he received the honorary degree of LL.D. from the University of Michigan; he is a member of the American Institute of Electrical Engineers and a corresponding member of several foreign scientific societies. As honorary secretary of the Texas Academy of Science he was successful in laying the foundations of a flourishing society.

Personally Dr. Macfarlane is a characteristic Scotsman, sturdy, persevering, with a relish for hard work, thoughtful, courageous in his convictions, and critical of the statements not only of others but of himself also.

His memoirs may be classified under three heads, viz.: Experimental and electrical, space analysis, logico-mathematical.

Under the first head comes his doctor's thesis "On the Disruptive Discharge of Electricity" published in the Transactions of the Royal Society of Edinburgh for 1878. In this paper it was for the first time shown that for pressures less than an atmosphere and greater than 2 mm, the connection between the difference of potential required for a spark and the pressure of the air is given by a branch of a hyperbola, the real axis of which corresponds to the pressures and the imaginary axis to differences of potential. He also showed that so long as the distance between two parallel plates is small, the difference of potential for a spark depends in the same manner upon the distance between the plates. This paper was followed by a number of others on closely related subjects; namely: "On the Discharge of Electricity Through Oil of Turpentine," Trans. R. S. E., 1878; "On the Disruptive Discharge of Electricity," Part II., Trans. R. S. E., 1878, Part III., 1879; "On the Discharge of Electricity," Phil. Mag., 1880; "Discharge of Electricity Through Colza Oil and Other Liquids," B. A. Report, 1881; "Positive and Negative Electric Discharge," Proc. R. S. E., 1880; "Effect of Flame on the Electric Discharge," Proc. R. S. E., 1882; "Arrangement of the Metals in an Electro-frictional Scale," Proc. R. S. E., 1884; "On the Electric Strength of Solid, Liquid, and Gaseous Dielectrics," Physical Review, 1893. In these papers it was shown for the first time that in the case of a liquid dielectric the difference of potential required for a spark is proportional to the distance between the parallel plates. He also found that for a given length of spark between a ball and a disc the potential difference between the electrodes was smaller when the ball was positive than when it was negative.

Dr. Macfarlane is very widely known both in this country and in Europe, because of his work in space-analysis. So long ago as 1883 he communicated to the Royal Society of Edinburgh a "Note on Plane Algebra," which stated briefly the view he had arrived at concerning the imaginary algebra of the plane. Starting from the "Analysis of Relationships" he had independently re-discovered the principles of Argand's method, and this gave him a point of advantage from which to study Quaternions and the more general problem of the algebra of space. He has now published five papers, viz.: "Principles of the Algebra of Physics," (1891), "The Imaginary of Algebra" (1892), "The Fundamental Theorems of Analysis Generalized for Space" (1892), "On the Definition of the Trigonometric Functions" (1893), "The Principles of Elliptic and HyperbolicAnalysis" (1893).

The object of the "Principles" is to found an analysis which will harmonize and unify Quaternions, Grassman's method, and Determinants, and apply directly to physical quantities in space. It is called the algebra of physics because it deals with the ideas of mass and time as well as the idea of space. The methods of Hamilton and Grassmann are harmonized and unified, but it is a mistake to suppose that they are identified; according to Macfarlane's view they are complementary to one another. One part of space analysis deals with the product functions of line-vectors, another part with the composition of versors, that is, of area-vectors, or angles in the most general sense; the *Ausdehnungslehre* is a fragment of the former, *Quaternioms* of the latter. In the paper on "Fundamental Theorems," the principles of spherical trigonometrical analysis are established, and the key to the whole development lies in the discovery of the Exponential Theorem for the sphere. The remaining two papers take up the composition of elliptic and hyperbolic angles, and lay the foundations of the more general trigonometry of the ellipsoid and hyperboloid. A paper "On the Analytical treatment of Alternating Currents" read at the International Congress at Chicago, another "On Physical Addition or Composition" read before the A. A. A. S. at Madison, show the power of the analysis when applied to a special problem.

His mathematical papers are numerous and varied, but they all bear the impress of a logician. The more important are: "An Analysis of Relationships," 1881; "Analysis of Relationships," Applied to Various Problems," 1882; "On Voting," 1884; "The Logical Spectrum," 1885; "The Fundamental Rules of Algebra;" "On Exact Analysis as the Basis of Language," 1892. At the meeting of the American Mathematical Society recently held in Brooklyn he read a paper "On the Fundamental Laws of Algebra," in which he advocated a real, not a formal, basis for the science.

Relation Between Line Wire Losses and the Over Compounding of Dynamos.

BY E. P. ROBERTS.

The sizes of the conductors in a multiple arc system are calculated on the basis of a certain percentage of loss in the conductors at some definite load. The loss in the line increases from zero at no load to the designed percentage at full load. Therefore the potential difference (P. D.) at the station must increase at the same ratio.

The over-compounding of dynamos is intended to automatically maintain a constant P. D. at the translating devices, or at some central point in the system, analogous to the center of gravity of a body.

If the system is for 110 volts and 10 volts loss at full load (not necessarily estimated for simultaneous use of all the translating devices connected in circuit) then, at 10 per cent. load 111 volts is needed at the station, at 15 per cent. load, 115 volts, and at full load, 120 volts.

The compounding and connecting up of the dynamos to the circuits is designed in accordance with one of three plans:

Case 1.—Over-compounding each dynamo in the same ratio as the line loss. If there is a 5 per cent. loss in line, over-compound 5 per cent. (a) If only one dynamo is used and it have a capacity equal to the full load estimated for the line, the voltage will rise in the proper ratio of P. D., at the dynamo terminals, to current output. (b) If, however, more than one dynamo be used and each dynamo be over-compounded in the same ratio as the line loss and the dynamos be connected in multiple when desired, the design is incorrect. It is to call attention to the above fact, and to the degree of loss resulting from the same, that this article is written.

Case 2.—The wiring is divided into a number of circuits and the dynamos are over-compounded in the same ratio as the line loss, and when more than one dynamo is needed the circuits are divided, a portion being thrown on to each dynamo in operation, each dynamo and its circuit being entirely independent of all others. This method is correct in principle.

Case 3.—The series windings of all dynamos are permanently connected in parallel by an equalizing wire and the result is that each dynamo, when operating singly, only increases the P. D. at its terminals to the proper amount, which depends upon what percentage its total output is of the total line load. As more dynamos are added the current increases in the series windings and with consequent increase of P. D. This method also is theoretically correct.

The P. D. at the dynamo is often termed the E. M. F. of the same. It is sometimes convenient to consider it as such, although the E. M. F. properly includes besides the P. D. at the binding posts, the P. D. lost inside the dynamo.

Case 1, (b) This, as before stated, is the special object of criticism. If the designer of an electric light plant for incandescent lamps specifies that the wiring for a certain load must be so proportioned that there will not exist, at such a load, between any two lamps a difference of more than two volts and he then introduces conditions resulting in a total variation, under varying conditions of load, of four volts, he is, to put it mildly, inconsistent.

When a designer specifies the clause above stated and then adds that the dynamos must be operative in parallel and does not design for Case 3, he is open to the above charge, and, if he accepts the plant, his test is open to adverse criticism.

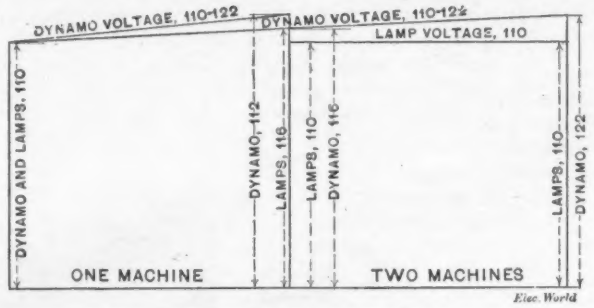
If the plant be designed for a certain wire loss and each dynamo be over-compounded to the same degree, then, at full load, and all dynamos working together, the desired P. D. is obtained, and if they all remain in operation until the highest load is reached, the desired P. D. will be retained, with more or less constancy, at the lamps; but if, when the load becomes sufficiently small for any one dynamo to carry it all, and such dynamo then be thrown off, the loaded dynamo will then give its maximum P. D.; but as the line is lightly loaded, the line loss will be less than at the maximum load and the P. D. at the lamps will rise to a degree depending upon the ratio of full load of dynamo to full station load. If the line loss at the maximum load be considerable and any dynamo unit be a small fraction of the maximum station load, the resulting increase of P. D. may be very considerable. Even if such be not the case the resulting decreased life of the lamps, and especially the decreased efficiency during the life, may be well worth considering.

For example, consider a plant of 2,400 maximum load, 110 volts lamps and 5 per cent. line loss, the dynamos to be over-compounded for 5 per cent. and to operate in parallel at full load. If one dynamo be a 250-light machine, for day and late night load, and operates by itself an average of 200 lights for 10 hours of the 24 for 300 days per annum, the result will be about 114.5 volts at the lamps, (115 at the dynamo) for such time as 200 lights are used, and this will materially affect the life, reducing it possibly one-half. The direct result in loss of money for lamps would therefore be, on an average life of 800 hours, and cost in place of 35 cents.

$$\frac{200\ (\text{lamps}) \times 10\ (\text{hours}) \times 300\ (\text{days})}{800\ (\text{hours})} = 750\ \text{lamps},$$

and, as the life is cut in half, 750 lamps in additional will be needed, which, at 35 cents amounts to $262.50 per year. It is true this is not a large amount, but it is well worth saving. It is less than the actual loss, as it represents only lamp expense and, as before stated, the efficiency is reduced even more rapidly than the life.

Large isolated plants are not uncommonly designed with 10 per cent. line loss and, in such a case, the evil would be increased four-fold, or more, under the same general conditions. In a 110 volt plant having two dynamos, of equal capacity, the following diagram represents the conditions with 10 per cent. line loss.



Showing Relation of Voltages.

The straining is usually aggravated by the fact that the lights on all branches are not turned on and off in the same ratio and therefore one or more circuits must necessarily receive more P. D. Therefore, having such a plant, the circuit should be arranged as in Case 2, or hand rheostats should be inserted in the shunt windings of the dynamos, and the P. D. regulated by hand, either in accordance with a voltmeter indicating from one or more centres of distribution, or by increasing the P. D. in the ratio of the line loss to the current flowing, as indicated by an ammeter and by a voltmeter connected at the station end of the mains.

A Peculiar Phenomenon.

BY W. W. VINCENT.

A note on "A Peculiar Phenomenon" in the Electrical World of Sept. 15, recalls an experience somewhat similar to the one mentioned, though its cause may be more easily explained. A short telephone line running southeast and northwest had an ordinary extension bell at its southern end and a battery of three cells; at the northern end was a magneto relay and local battery and bell. The battery at the southern end was set up some two months ago and so connected that its E. M. F. was in the same direction as that of an earth current which was found to exist. Sheet iron plates having an area of 4 square feet each were used at each end.

The first heavy thunder storm since putting up the line occurred on Sunday, Sept. 16, when the line refused to work. On testing with the transmitter battery and a galvanometer in circuit, the E. M. F. of the earth current was found to have changed sign and was consequently in opposition to the E. M. F. of the cells. The transmitter cell was then placed in the circuit with the same polarity as that of the earth current, with the result that a call was established at the other end of the line. The battery of three cells was again tried but refused to work until connections were reversed. A few days later on the approach of a similar storm the relay, which has a resistance of 20 ohms and is not very delicately adjusted, had to be disconnected to prevent the local bell from running continuously. Such a strong earth current over a line of less than one mile in length appears to be somewhat remarkable.

Progress and Simplification.

One of our English contemporaries differs from Herbert Spencer when it remarks that progress means simplification, and that "unless we get this we have not advanced a step, shuffle the cards as you may."

Copper Production.

According to some recently published statistics the United States produces nearly as much copper as all of the rest of the world together.

Notes on the Management of Railway Power Stations—II.

BY GEORGE T. HANCHETT.

THE STEAM FITTING.

The pipe line appears at first sight so small a portion of the anatomy of a power-station that to devote much space to it in such general notes as these seems absurd. The importance of the pipe line is nevertheless great, and the proper performance of its function is so necessary to general economy that it cannot be neglected. The average station engineer sometimes has to install or repair a line of steam pipe and a few hints as to its construction and its losses may be useful. The loss to be dreaded most is the loss of heat from radiation. The necessity of thoroughly protecting steam pipes by non-conducting coverings is so great that the best covering the market affords is none too good. The following problem, solved by a rule given by a competent authority, will show better than words the necessity of careful attention to this matter. Suppose we have an uncovered steam pipe of 6″ standard and 60 feet long conveying steam at a pressure of 90 lbs. How many horse power are lost by radiation, the temperature of air being 80 degree F.? The heating area of 60 feet of 6″ standard pipe is practically 104 square feet. The temperature of saturated steam at 90 lbs. gauge is 331 degrees F. .058 is an empirical constant. The heat units lost per minute are (331°—80) x104 x .058 = 1514. nearly. Assuming the mechanical equivalent of heat 778 the horse power lost is

$$\frac{1514 \times 778}{33{,}000} = 35.7\text{-hp.}$$

This figure is rather startling and the more so when we realize that at 90 lbs. pressure a six inch-pipe is none too large for a 130-horse power engine, and that if such a pipe line as this just discussed were used, about 27½ per cent. of the energy would be lost. Moreover the energy that is lost is the very energy of the steam that the engine is able to utilize. The engine cannot operate economically on steam laden with moisture and robbed in a great part of the heat equivalent of external work. It is hardly necessary to say that the exposed portions of the boiler need to be well protected also. Moist steam may be avoided in a great measure by the use of a separator, and the station superintendent should insist on having one where the pipe line is at all long. There are many good types of separators on the market, all of which are of more or less value. Fig. 2 shows a form of separator which may be made out of steam

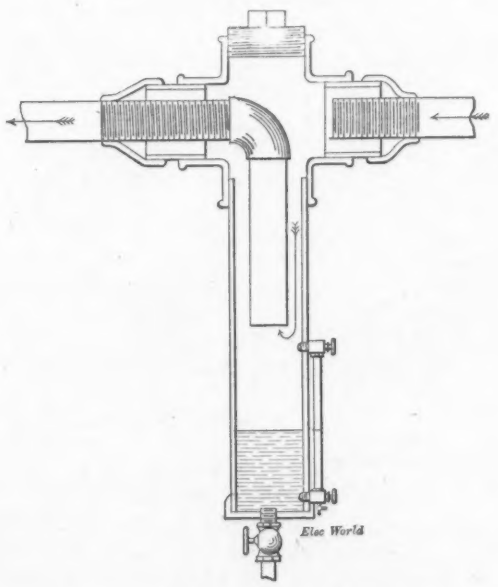


FIG. 2.—STEAM SEPARATOR.

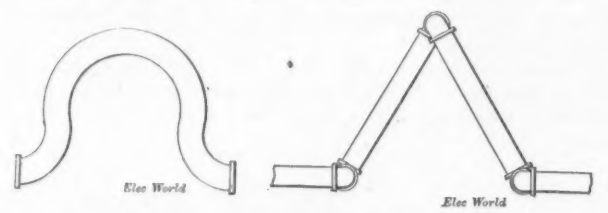
fittings with a little labor and patience. It may be drained automatically by a steam trap, or a glass gauge and cock may be used as shown. A separator should be placed as near the engine as possible and both pipes should incline toward it in order that the condensation shall drain into the separator. A separator is useful in that it momentarily intercepts the water from a foaming boiler. With a little experience and experiment it is very easy to detect wet, dry, and superheated steam by simply observing it as it issues from an orifice. Superheated steam will not be visible till it has issued a considerable distance from the orifice, an inch or even more. Dry steam will be faintly visible at the orifice and gradually increase in its cloudy whiteness as it proceeds on. Steam with a small percentage of moisture, 1 to 2 per cent., will appear quite white at the orifice and will increase in its capacity but little as it proceeds. Steam from a foaming boiler will appear a dense white at the orifice and will often be accompanied by a sputtering sound similar to that of blowing off a gauge cock at or near the water line. The importance of dry steam in the economy of the engine will be shown later on. The water in steam pipes is not only prejudicial to the safety of the engine, but to the pipes themselves. If steam is turned into a pipe containing water the latter is thrown violently against the sides of the pipe producing the "ramming" or "water hammer" which is liable to burst the pipe. Hence it is important to have a system of steam pipes efficiently drained on its own account. For this reason a steam pipe should not drain into the boiler, especially if it be a long one. The steam meeting the reversed current of water may do serious damage to the pipe by ramming.

Unless steam pipes are installed with due care expansion will prove a serious source of trouble. By exercising a little ingenuity in the jointing of the pipes the effect of the expansion may be made to simply turn the pipe in its fittings and not break it off close thereto. An iron steam pipe 40 feet long and raised 300 degrees above the atmosphere will expand about an inch. If connected to

FIGS. 3 AND 4.—PIPE CONNECTIONS.

an engine as shown in Fig. 3 the pipe will be broken off short at B, C, or D, while if connected as in Fig. 4 this difficulty will be avoided.

Long lines of pipe may be relieved from the effects of expansion by the introduction of a flexible spring loop of iron pipe bent as



FIGS. 5 AND 6.—FLEXIBLE LOOPS.

shown in Fig. 5, or by a swing joint such as in Fig 6. Care must be taken that these joints are not so arranged as to form pockets for the accumulation of condensation. Packed expansion joints usually prove more trouble in themselves than the difficulty they were designed to remedy.

To figure the proper thickness of a steam pipe for a given pressure the following simple rule will suffice. Let T represent the thickness to be found, P the working pressure in pounds per square inch, and F the safe working strength of the material of the pipe. Then if R represents the radius of the inner circumference

$$T = \frac{P\,R}{F} + C,$$

where C is a certain constant given in the table beyond. If the pipe were subjected to internal pressure only and was not liable to mechanical strains from without this constant could be neglected. The value of F should be carfully chosen. It is obtained by dividing the breaking stress by a factor of safety, and the more a pipe is subjected to alternate heating and cooling or to the water hammer the larger this factor should be.

Material.	Ultimate Resistance to Tension.	F. With factors of safety, 4	5	6	C.
Wrought Iron....	48,000	12,000	9,600	8,000	.12
Cast Iron.....	20,000	5,000	4,000	3,333	.45
Copper.....	30,000	7,500	6,000	5,000	.125
Lead	3,300	825	660	550	.18
Zinc.....	7,500	1,875	1,500	1,250	.16

The constants in the column C are chosen from purely practical

considerations. 0.12 for wrought iron is chosen because a wrought iron pipe over 1 in. in diameter needs at least. 12 in. of thickness to give it sufficient strength to cut threads on it and resist mechanical stresses. .45 for cast iron was chosen because it is not possible to cast well and at the same time cheaply thinner pipes. Similar considerations have governed the choice of other constants.

Copper pipes with brazed seams are of uncertain strength. It is well to remember also that copper loses 15 per cent. of its tensile strength at 360 F. and as this is the temperature of steam at 177 lbs. gauge approximately it is a serious consideration.

The proper size of a steam pipe for an engine may be found by the following rule:

$$a = \frac{A\,S}{s}$$

where a=the desired pipe area, A=the area of the piston in square inches, S = the piston speed in feet per minute, and s = the velocity of the steam in the pipe in feet per minute. With straight, short runs of pipe s may be as high as 6,500. When the steam pipe is of ordinary length and with three or more bends 5,000 is of good value. Thus a McIntosh and Seymore engine 16x17 has a piston speed of 680 feet per minute; what is the proper size of steam pipe under ordinary circumstances?

$$\frac{\left(\frac{16}{2}\right)^2 \times 3.1416 \times 680}{5{,}000} = 27.34 \text{ nearly,}$$

and the diameter of a circle with 27.34 area is 5.9 inches, and the nearest standard size is 6″ the one used by the manufacturers.

The safety valve of a boiler is one of its most important adjuncts. It should be lifted every day to be sure it does not stick, and once a week at least the pressure should be raised so that it will blow off. The gauge pressure should be noted at this time and should agree with that for which the safety valve is set. If it does not, either the gauge or the valve is wrong and should be corrected. Two small safety valves are better than one large one.

The steam gauge on the ordinary boiler is of the Bourdon type. They work on the principle that a bent tube tends to straighten itself under internal pressure. This tube is of bronze or composition and will have its elastic properties changed if exposed to high temperatures. It is therefore necessary to prevent live steam from entering the gauge by interposing a pipe bent in a syphon shape so as to always contain water.

Glass gauges to indicate the height of the water should be frequently blown out as they are apt to become plugged up and hence unreliable The test cocks should be frequently used to check its accuracy.

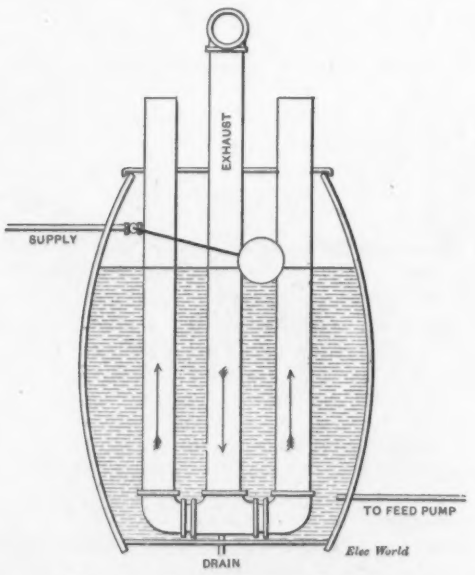


Fig. 7.—Feed Water Heater.

Never allow the exhaust steam from an engine to exhaust directly into the air. If the management will not supply a feed water heater, one may be made from a barrel or hogshead as shown in Fig. 7. It should be covered carefully to exclude any oil from the exhaust. Such an arrangement will tend to eliminate a noisy exhaust which otherwise would be a source of complaint, and although by no means perfect, will effect a saving far in advance of its cost and maintainance.

(To be continued).

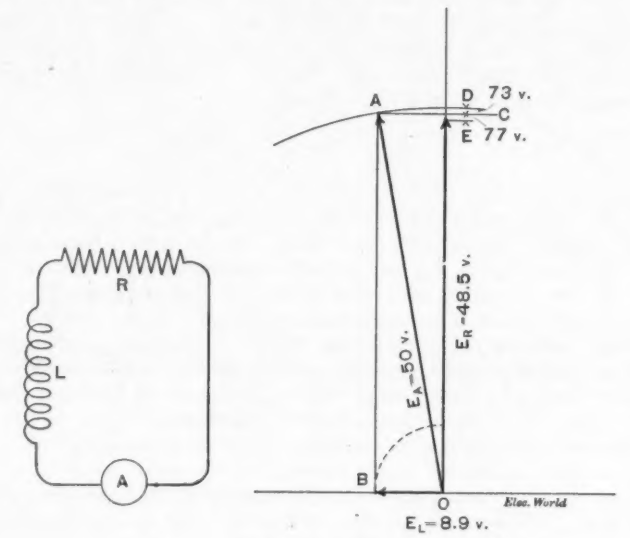
Alternate Current Working—VI.

BY HARRIS J. RYAN.

The American Institute of Electrical Engineers at a general meeting held in May, 1894, adopted at the suggestion of Messrs. Steinmetz and Bedell the term "reactance" to be equal to the component of the impressed E. M. F. at right angles to the current divided by the current. Stated in another way: Reactance equals the volts per ampere produced by self-induction or capacity. The reader is referred to a most instructive paper on "Reactance" by Messrs. Steinmetz and Bedell in The Electrical World, June 30, 1894, page 862. Reactance is a convenient term, and its use is illustrated in the following examples.

The American Institute of Electrical Engineers has also adopted the term "inductance" to be synonomous with coefficient of self-induction. Inductance is more acceptable because more convenient.

The diagrams of Fig. 18 illustrate one of the most common problems and its solution that is met with in alternate current working. We have a source of alternate current pressure at



Figs. 18 and 19.

A_1 = 50 volts at 125 p. p. s. R is a non-inductive load on a circuit of 100 incandescent lamps, and has a working resistance of .5 ohms. Appreciable induction is introduced into the circuit by the current through the motor meter at L. The induction produced in the balance of the circuit is negligible. The inductance at L, .000118 henrys, was determined in the following manner: An alternating current of 150 amperes at 125 p. p. s. was passed through the meter, and the alternating difference of potential between the terminals of the meter was observed on an alternating voltmeter and found to be 14 volts. The ohmic resistance of the meter from terminal to terminal is .008 ohms. The impedance of the meter then is

$$\text{Impedance} = \sqrt{R^2 + \omega^2 L^2} = \frac{E}{C}$$

$$= \sqrt{.008^2 + 785^2 L^2} = \frac{14}{150}$$

from which is determined the value

$$L = .000118 \text{ henrys.}$$

In this case for the determination of the inductance at L we might have neglected the ohmic resistance of the meter without sensibly affecting the result. There are many cases, however, where one cannot neglect the internal ohmic resistance of the apparatus or machinery in making such a determination. Under these circumstances then we know the values of the impressed E. M. F. resistance and inductance of the circuit ALR, and we want to deduce the current that will be established and the pressure that will be maintained through the lamps at R. The current may be determined from the relation

$$C = \frac{E}{\text{Impedance}}.$$

$$C = \frac{50}{\sqrt{[.5 + .008]^2 + (.00118 \times 2\pi\, 125)^2}} = 97 \text{ amperes,}$$

the pressure maintained on the lamps is

$$E_R = 97. \times .5 = 48.5 \text{ volts.}$$

The fall of potential through the meter due to ohmic resistance is

$$C\,R = 97 \times .008 = .776 \text{ volts.}$$

The E. M. F. of induction reactance in the meter is

$$E_L = C\,L''\,\omega = 97 \times .000118 \times 2\,\pi \times 125 = 8.9 \text{ volts.}$$

The total drop between A and $R = 50 - 48.5 = 1.5$ volts. Of this 1.5 volts, .776 has been accounted for by the ohmic resistance of the meter leaving a balance of $1.5 - .776 = .724$, which is the amount by which E_A is lessened by the counter action of the 8.9

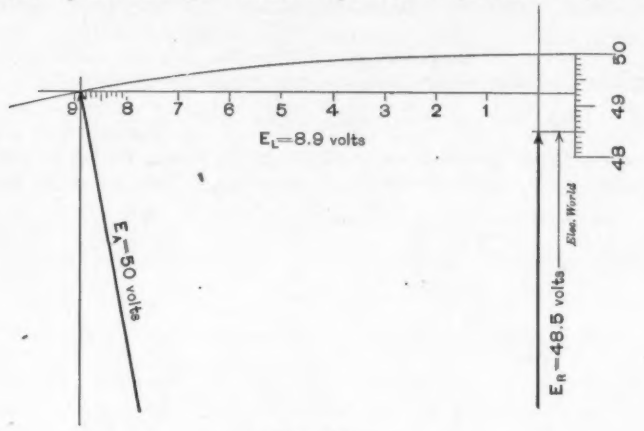
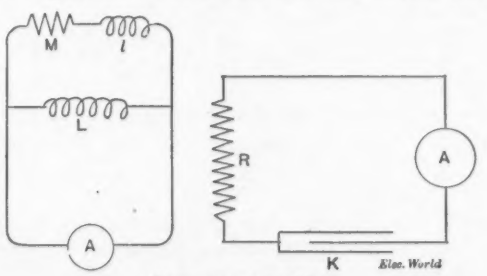


FIG. 20.

volts produced by the induction in the meter. In Fig. 19 these relations are expressed graphically. A distance AO is laid off on the vertical scale equal to the impressed E. M. F. or pressure of the alternator. The result of all falls of potential and induction E. M. F.'s in this circuit must be equal to this amount, just as in mechanics action and reaction are always equal. With O as a centre a circle is laid off, whose radius $O\,B = E_L = 8.9$ volts. On the left of this circle a tangent is drawn that passes through A. AB has a value of 90 degrees behind OB such that when they are combined OA will result. AB is, therefore, the value of the E. M. F. that is applied against the ohmic resistance of the circuit in establishing current. AB is equal to the product of the total ohmic resistance of the circuit into the established current. By completing the parallelogram of the E. M. F.'s we will get the exact time position of the three principal values E_A, E_R and E_L. $E_A = OA$, $E_L = OB$ and $E_R = OC$.

It is noted that E_L is in advance of E_A, and E_R is behind E_A. The current is always in unison with E_R so that it is likewise behind E_R, which has an important meaning when we come to the determination of power. The top of Fig. 19 is enlarged in Fig. 20 and the results may be read graphically direct from the figure.

Problem 2 (see Fig. 21), illustrates a case that occurs in practice where induction motors are used. A is an alternator furnishing current at a pressure of 1,000 volts and 125 p. p. s. This alternator furnishes current to an unloaded and a loaded induction motor. L is the circuit through the unloaded, and RL through the loaded motor. Ten amperes pass through the loaded motor at L, and may be called the induction current. The motor has so low an ohmic resistance that the falls of potential thus produced may, for our present purposes, be neglected. The instant that the motor terminals are



FIGS. 21 AND 23.

attached to the leads from the alternator, current is set up through the motor in such an amount that a sufficient alternating magnetization or induction takes place to produce a pressure in the motor conductors that is equal and opposite to that of the leads. This induction must be 90 degrees behind the alternator pressure and the induction current will, therefore, be 90 degrees behind that pressure. The motor that does work will take from the line in addition to this induction current a current that is in unison with its counter E. M. F. Induction motors are designed as far as practicable so as to have induction occur only in the circuits directly concerned with the development of mechanical power. This result is never entirely obtained, so that the circuit of the loaded motor acts as though that part of it were ohmic resistance and the balance self-induction. The self-induction part is represented by $l = .03$ henrys. We want to know the total current that the alternator must furnish, and the motor E. M. F., working current and induction current that the loaded motor will use at a total current of 15 amperes. The 15 amperes will produce a self-induction E. M. F. in the motor of $CL\omega = 15 \times .03 \times 2\pi \times 125. = 350$ volts. A current of 10 amperes through the motor when running light produces an E. M. F. of 1,000 volts equal and opposite to that of the line. Part of this is due to L, and amounts to $CL\omega = 10 \times .03 \times 2\pi \times 125 = 236.$ volts. The balance, $1000 - 236 = 764$, is due to induction through the conductors, that transform their electrical energy into mechanical power. These 764 volts are the motor E. M. F. of the motor when running light. We then have 764 volts of motor E. M. F. per 10 amperes of induction current. Every ampere of induction current will produce 7.64 volts of motor E. M. F.

In Fig. 22 line OD expresses this relation. The arc IBJ is laid off with a radius of 15 amperes, the total motor current; HK, with a radius of 350 volts, the self-induction E. M. F. of the motor; and FG with a radius of 1000 volts which is the pressure of the leads. To start the diagram that will produce the solution of our problem we select a point at E somewhat below the no load motor E. M. F. of 764 volts. A horizontal is then drawn to D, a perpendicular to A, and from the intersection of the arc at B, OB is drawn. This is the time position of the total motor current of 15 amperes. OA equals 9.7 amperes, the induction current. At right angles to OB, OH is drawn giving the time position $EI = 350$ volts. From H a vertical is drawn to an intersection of FG at F. From F a parallel to OH is drawn to an intersection with OG at E. $OE =$

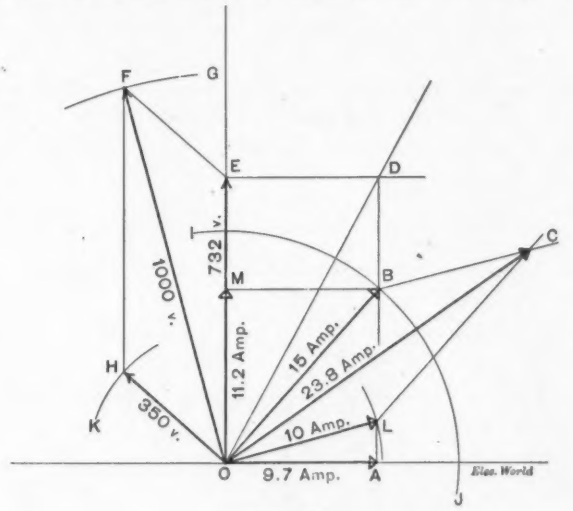


FIG. 22.

732 volts, is the desired working motor E. M. F. In general this intersection of OG will not occur quite at E, and the position of E is adjusted until the two coincide when the diagram is accurate and the solution complete. To know the total current that the alternator will furnish to the motors we must add the induction current of 10 amperes of the motor that is running light to the total current of 15 amperes of the working motor. To do this $OL = 10$ amperes is laid off one-quarter period behind the impressed E. M. F., OF. The parallelogram defined by OL and OB is completed and we obtain the diagonal $OC = 23.8$ amperes as the total current that the alternator must furnish.

(To be continued.)

Three-Phase Motors in Switzerland.

From some interesting statistics just published it appears that out of 99 motors installed in the year 1893 in Switzerland, 41 were for three-phase currents, 23 for single phase and 4 for two-phase currents and 31 for continuous curreuts.

Development of Industrial Instruction in America.

A French writer on this subject says in an electrical contemporary that Frenchmen agree that Americans have an initiatory spirit compared with which that in France cuts a sad figure.

Electrodynamic Machinery—XI.

BY E. J. HOUSTEN AND A. E. KENNELLY.

50. The specific reluctance of iron, that is, the reluctance of unit volume measured between parallel faces, is called its *reluctivity*. The reluctivity of air-pump vacuum is unity; the reluctivity of air, wood or glass, etc., is practically the same. The reluctivity of iron may be as low as 0.0005, but varies with the flux density. That is to say, the reluctance of a cubic centimetre of iron, measured between parallel faces, may be as low as 0.0005 oersted.

51. The fact has been established by observation, that in the magnetic metals, within the limits of observational error, a linear relation exists between reluctivity and magnetizing force. That is to say, within certain limits, as the magnetizing force brought to bear upon a magnetic metal increases, the apparent reluctivity of the metal increases in direct proportion. Thus, taking the case of soft Norway iron, its reluctivity, at a magnetizing force or prime magnetic intensity of 4 gausses, may be stated as 0.0005. Increasing the magnetizing force, the reluctivity increases by 0.000057 per gauss, and this increase, plotted graphically, would be represented by a straight line.

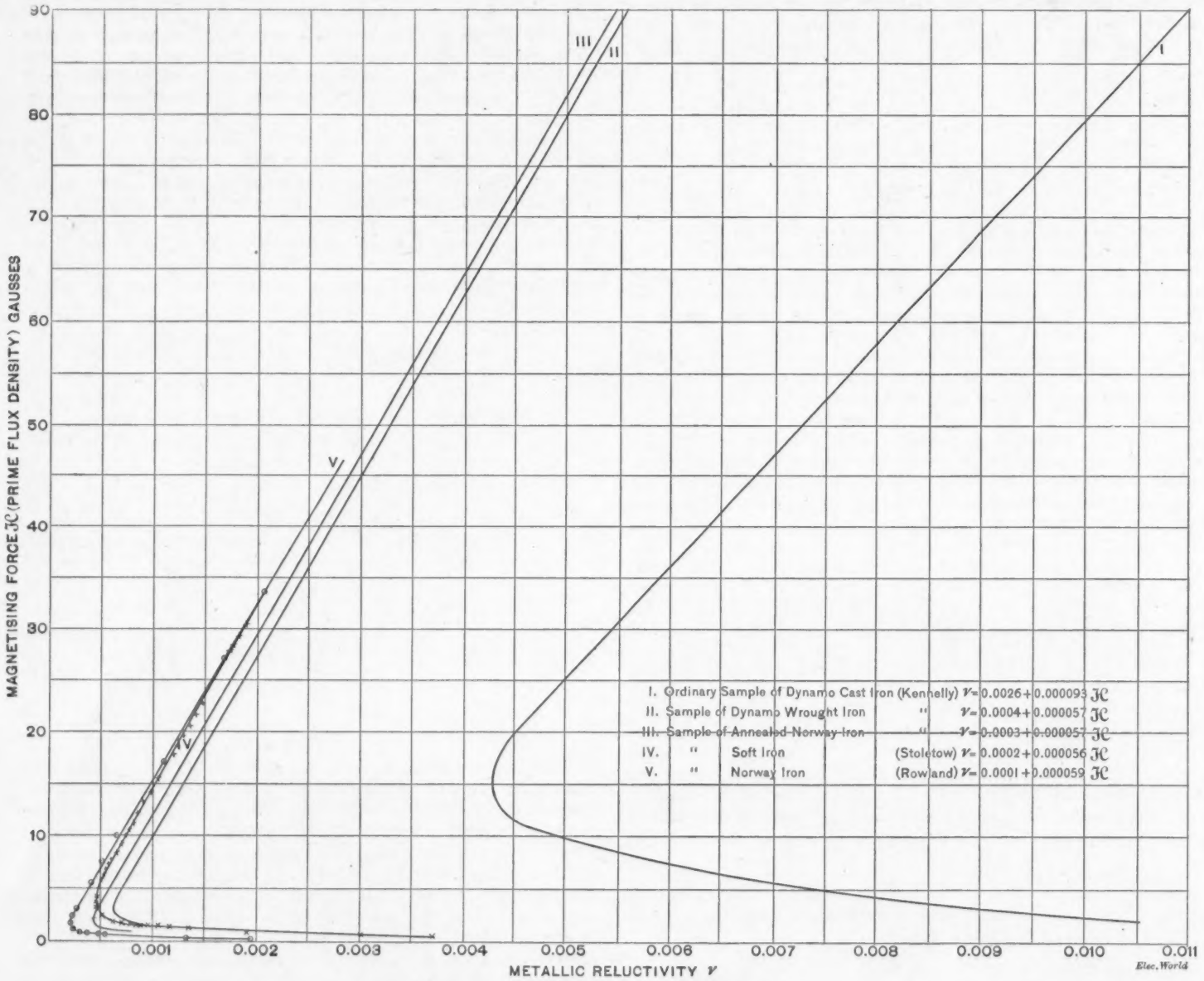


FIG. 46.—CURVES OF RELUCTIVITY.

52. The accompanying curve sheet represents the results of acual observations by different observers upon different samples of soft, wrought iron and cast iron. It will be seen that in the early stages of magnetization, below a critical magnetizing force, which varies with different samples from 1 to, perhaps, 15 gausses, (the latter in the case of cast iron), the reluctivity decreases with an increase in magnetizing force; but, when the critical magnetizing force is reached, the direction of the curve changes and the value becomes linear. Strictly speaking the linear relation of reluctivity and magnetizing force, represented in the figure, is true only for the apparent reluctivity of the metal itself, and is irrespective of the ether which pervades the metal; for, were this relation strictly linear for all values of the magnetizing force beyond the critical value, then the reluctivity would become infinite with an infinite magnetizing force; whereas, by observation, the reluctivity of the most highly saturated iron never exceeds unity, that of the air pump vacuum, or approximately that of air. In point of fact we may consider the magnetism as being conducted through two paths in multiple arc; namely, that of the magnetic metal proper, and that of the ether permeating the metal. The first path may be called the *ferric path of metallic reluctivity*, and has a reluctance varying from a minimum at the critical magnetizing force, up to infinity, by the linear relation. The second path is the *ether path of reluctivity*, and is generally assumed to have a constant reluctivity of unity. The joint reluctivity of the two paths will be $\frac{1 \times \nu}{1 + \nu} = \frac{\nu}{1 + \nu}$ where ν, equals the reluctivity of the ferric path. Since in actual dynamo machinery the value of the magnetizing force is never much more than 80 gausses, the above consideration is of small practical importance, since ν is always much less than unity, say 0.01, and the discrepancy introduced by taking account of the multiple connected ether path, is only the difference between 0.01 and $\frac{0.01}{1 + 0.01} = \frac{0.01}{1.01}$ or about 1 per cent., so that, for all practical purposes, we may assume that the metallic reluctivity is the actual reluctivity of the iron.

Beyond the critical magnetizing force, therefore, the value of the metallic reluctivity may be readily obtained by the equation $\nu = a + b\ \mathfrak{H}$, where a, is the reluctivity which would exist at zero magnetizing force, if the linear relation held true below the critical value, and b, is the increase in reluctivity per gauss of magnetizing force expressed by $\mathfrak{H}$. According to the fundamental C. G. S.

system reluctivity is a numeric, and its value can never exceed unity. Thus for wrought iron a, = 0.0004, and b =0.000057.

53. If the ring shown in Fig. 44 be composed of wood and excited by 1,000 ampere turns = 1,257 gilberts, then, since its mean length of circuit (circumference) is 60 cms, and cross sectional area 10 sq. ms, its reluctance will be 6 oersteds, the flux $\frac{1,257}{6} = 209.5$ bweres, and the intensity $\frac{209.5}{10} = 20.95$ gausses, so that the magnetic force has a rate of descent of magnetic potential, the uniform distribution of which is $\frac{1,257}{60} = 20.95$ gilberts per centimetre = 20.95 gausses. Strictly speaking the intensity of the magnetic flux is not uniform over all portions of the area of cross section of the core, being denser at the inner circumference and weaker at the outer circumference. For example, if the inner circumference, instead of being 60 cms., which is the mean, be 58 cms, the gradient of magnetic potential will be uniformly $\frac{1,257}{58} = 21.67$ gausses; while if the outer circumference be 62 cms, the intensity of that circumference will be $\frac{1,257}{62} = 20.27$ gausses. Since, however, all such existing differences of intensity can be made negligibly small, by sufficiently increasing the ratio of the size of the ring to its cross section, we may, for practical purposes, omit them from consideration.

54. Suppose now the core of the ring be composed of soft, Norway iron instead of wood; then from the curves, or the equation,

$$\nu = 0.0004 + 0.000057\ \mathfrak{H},$$

we find that at this mean intensity of $H = 20.95$

$$\nu = 0.0004 + 0.001194 = 0.001594,$$

or about 1-600th of that of air. The mean length of the circuit being 60 cms., and its area, as before mentioned, 10 sq. cms, its reluctance under these circumstances will be $\frac{60}{10} \times 0.001594 = 0.009,564$, oersted, and the flux in the circuit $\frac{1,257}{0.009564} = 131,430$ webers, with an intensity of $\frac{131,430}{10} \div 13,143$ gausses.

If the core of the ring instead of being of soft Norway iron be made of cast iron, the reluctivity, at 20.95, would be approximatelv 0.0046, and the reluctance of the circuit 0.0276 oersted, making the total flux 45,540 webers, with an intensity of 4,554 gausses, or about three times less than with soft, Norway iron. The practical advantages, therefore, of constructing cores of soft, Norway iron, rather than of cast iron, when a high intensity is required is manifest.

(To be continued.)

Action of a Transformer with a Condenser in Parallel with the Secondary—IV*.

BY F. BEDELL AND A. C. CREHORE.

EFFECTS OF THE VARIATION OF SECONDARY LOAD WHEN THE PRIMARY CURRENT IS CONSTANT.

By means of Fig. 7, which has been explained, we may construct the constant current diagram for a variation in the line resistance R. This diagram is represented in Fig. 12, where OB is the constant electromotive force impressed upon the transformer secondary. Construct the triangle BO′, Fig. 12, similar to B′OC, Fig. 7.

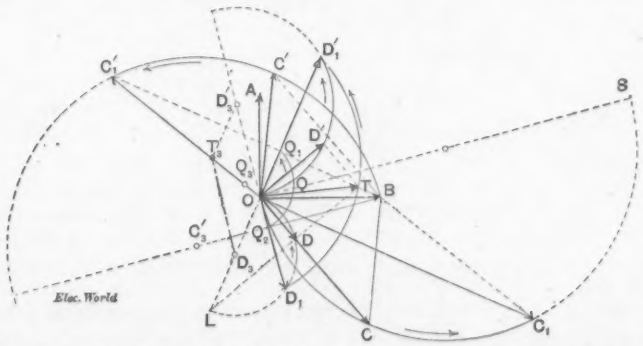


FIG. 12.—CONSTANT PRIMARY CURRENT DIAGRAM SHOWING EFFECTS OF VARYING THE LINE RESISTANCE.

the line OC_1 then represents the position of the condenser E. M. F. upon open circuit. The diameter of the circle upon which OC varies is found by drawing a line OS so that the angle BOS, Fig. 12, is equal to the angle COP, Fig. 7, between the fixed line OC and the perpendicular OP upon the line BB′. The magnitude of the diameter may be found by drawing from C_1 a perpendicular to OC_1 and producing until it meets OS. The locus of OC, the condenser E. M. F., is then represented by the arc OCC_1. The locus of the E. M. F. for the transformer impedance is now determined because the sum of OC and OC¹ gives OB. Hence OC′ lies upon a circle $C_1'C'B$ symmetrically situated with respect to OB to the circle OCC_1.

The condenser current is now determined; for it is represented in Fig. 7 by the constant line OD′, a right angle in advance of OC, and equal to $C\omega$ times OC. In Fig. 12 this is represented by the arc $OD'D_1'$, the diameter of which is a right angle in advance of OS and equal to $C\omega$ times OS.

The locus of OQ, the E. M. F. for the transformer resistance, is found by drawing a circle with center Q_2, a point which lags behind C'_2 by the constant angle arc tan $\frac{L_2\omega}{r}$ This gives for the locus of QO, the arc Q_1QQ_2. From this the transformer current OT is determined; for it is always a constant multiple of OQ, $OQ = rOT$. One point on the locus is known to be D_1', for here the condenser current is zero. Another point is known to be D_1; for here the condenser here is zero. The centre of the circle T_2 lies upon OQ_2 produced so that $OQ_2 = rOT_2$.

The locus of the line current is upon the arc ODD_1L, the diameter of which OL is a right angle behind OC, or two right angles behind OD_1'. This will appear from the consideration that OT is the geometrical sum of OD and OD′, or that OT_2, is the sum of OD_2' and OD_2 the lines drawn from O to the centers of the respective circles. The heavy part of the circles indicates the range within which a variation may take place and the arrow shows the direction of such varia ion with an increase of line resistance.

ACTUAL DIAGRAM FOR CONSTANT CONDENSER POTENTIAL WHEN THE LINE RESISTANCE IS VARIED.

Fig. 7 represents the case where the line resistance is varied and the condenser potential constant; but it is the typical case and the lines are not drawn to scale. The self induction, too, is not very large compared with the transformer resistance. On the other hand

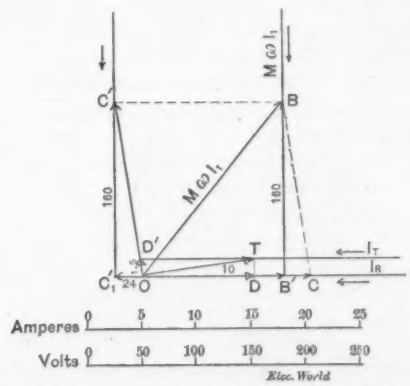


FIG. 13.—ACTUAL CONSTANT CONDENSER POTENTIAL DIAGRAM WHEN $\frac{L_2\omega}{r}$ IS VERY LARGE.

Fig. 13 represents the diagram drawn to scale for the particular case of the transformer, the data of which has already been given. The condenser and line potential is arbitrarily chosen as 150 volts, and the capacity of the condenser in parallel with the transformer is 10 microfarads. The particular value of the line resistance represented is 15 ohms, a rather high value. This makes the constant condenser current OD_1 equal to 1.5 amperes, and the line current 10 amperes, for this particular resistance. The transformer current OT will then be only a little more than 10 amperes. The E. M. F. OC′ for the transformer impedance is equal to $L_2\omega$ times OD′, upon open line circuit. This gives OC′ equal to 24 volts. Hence OB′ is 150—24, or 126 volts. The inductance, $L_2\omega$, being equal to .016 × 1000 or 16, is large compared with the internal resistance .16 ohms, and therefore the angle C′OQ of Fig. 7, the typical diagram, becomes here a right angle, C′OT. Thus the locus of the impressed E. M. F. OB becomes a line perpendicular to OC.

This diagram may now be easily transformed into the constant current diagram.

*The preceding sections of this article, which is here concluded, appeared in the issues of August 11, September 8 and 29, 1894.

ACTUAL CONSTANT CURRENT DIAGRAM WHEN THE LINE RESISTANCE IS VARIED.

Fig. 14 is the constant current diagram for the case under consideration. It may be derived directly either from Fig. 13 or from Fig. 12. If we take it from Fig. 12 it is simply necessary to make the angle $C_1'OQ_1$ a right angle and all other angles which immediately result from it. Thus the angle BOS of Fig. 12 vanishes in Fig. 14 so that OB coincides with the axis of the semi-circle OCC_1. The diameters of the current circles OL and OD'_1 become perpendicular

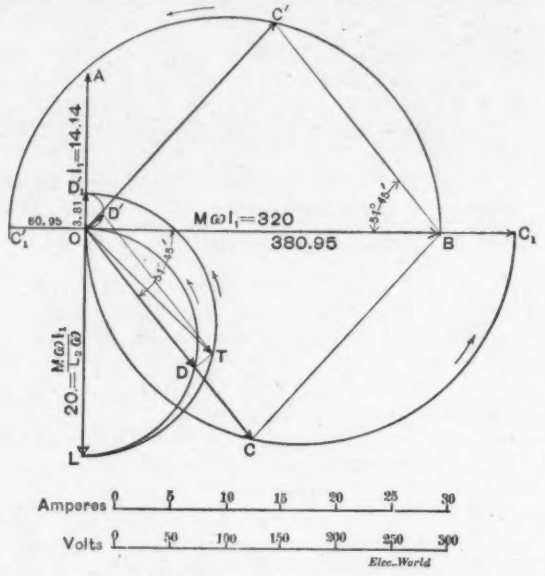


FIG. 14.—ACTUAL CONSTANT CURRENT DIAGRAM WHEN THE LINE RESISTANCE IS VARIED, AND $\frac{L_2\omega}{r}$ IS LARGE.

to the impressed E. M. F. OB; for (Fig. 12) the radius OD'_3 is always at right angles with OS, but in Fig. 14 OS coincides with OB. So also OL is always at right angles to OC_1, but in Fig. 14, OC_1 and OB coincide in direction. The resultant or transformer current circle has its diameter coincident with and equal to the sum of OL and OD_1'.

To consider the figure more in detail the primary current of 14.14 amperes maximum value, OA, causes an impressed E. M. F. OB upon the transformer secondary which is equal to $M\omega I_1$, or to $\sqrt{L_1 L_2}\,\omega I_1$; and numerically gives $\sqrt{.032 \times .016} \times 1000 \times 14.14$ or approximately 320 volts.

Upon open line circuit we have a single series circuit through tranformer and condenser, the impedance of which is

$$\sqrt{r^2 + \left(\frac{1}{C\omega} - L_2\omega\right)^2}.$$

Numerically this is—

$$\sqrt{.16^2 + \left(\frac{1}{10^{-5} \times 10^3} - .016 \times 1000\right)^2},$$

or approximately 84. Therefore the condenser current which flows upon open circuit is equal to the impressed E. M. F. 320 divided by the impedance 84, that is 3.8095 amperes. This is the value of the diameter OD'_1 of the condenser current locus. The electromotive force OB or 320 volts is the algebraic sum of two components, one OC_1 to drive this current through the condenser and the other for the transformer impedance. The condenser E. M F. OC_1 is equal to the current OD'_1 divided by $C\omega$, that is, is equal to $\frac{3.8095}{10^{-5} \times 10^3} = 380.95$. So also the transformer part is equal to $L_2\omega$ times this current or $.016 \times 1000 \times 3.8095 = 60.95$ volts. The difference between these E. M. F's viz: 380.95—60.95=320 the impressed E. M. F. Upon short circuit the condenser terminals are joined by a wire of zero resistance and there is then no potential difference at the condenser terminals, and consequently no condenser current. All that we have then is a simple circuit, of impedance

$$\sqrt{r^2 + L_2^2\omega^2} \text{ or } \sqrt{(.16)^2 + 16^2} = 16 \text{ approx.},$$

and impressed E. M. F. 320 volts. This makes transformer and line current equal to $\frac{320}{16} = 20$ amperes. This value of the line current upon short circuit is the same as without a condenser. The circle ODL representing the line current locus is the same as if the condenser were not present at all. But this difference is to be noted, *that while the locus is the same it does not follow that for any given line resistance the line current will be the same in the two cases either in direction or in magnitude.* This may be best illustrated by a numerical example. We will suppose that the line resistance is 15 ohms, and that we first have no condenser present, and then secondly connect in the condenser.

In the first case, with no condenser, we have OD lagging behind OB by an angle

$$\text{arc tan } \frac{L_2\omega}{r + R} \text{ or arc tan } \frac{16}{15.16} = \text{arc tan } 1.056.$$

The angle of lag is then 46°30′. The current is then equal to 320 cos 46° 30′ /15.16 or to 14.5 amperes.

In the second case, when the condenser is present, we may perhaps most easily find the angle of lag by reference to Fig. 13 from which Fig. 14 is derived. The angle BOC is the same in either figure. It may be obtained as follows from Fig. 13. The tangent of BOC is equal to BB′ divided by OB′ and OB′ is equal to $OC - OC_1' = 150 - 24 = 126$. But $BB' = C'C'_1$. We have the proportion from the similar triangles $OC'C'_1$ and ODT that $\frac{O\,D}{T\,D} = \frac{C'_1\,C'}{OC'_1}$. Hence we have

$$C_1\,C = \frac{OD \times OC_1}{T\,D} = \frac{10 \times 24}{1.5} = 160 \text{ volts.}$$

This makes BOC = arc tan $\frac{160}{126}$ = arc tan 1.27; and $\theta = 51°\ 45'$ which is a larger angle of lag than when the condenser was absent.

Referring again to Fig. 14, we may find the magnitude of the current by taking the value of OL sin 51° 45′ or 20 sin 51° 45′ which is 15.7 amperes approximately.

The example shows that shunting the condenser around the secondary actually increases the line current which existed before, and of course also the effective E. M. F. at the line and condenser terminals, but at the expense of increasing the phase difference between the current and impressed E. M. F.

Up to this time no mention has been made of the reaction of the secondary current upon the primary electromotive force and current. It is thought that a single typical example illustrating the case just considered, where the secondary self induction is large as compared with the internal resistance, will suffice.

CONSTANT CURRENT DIAGRAM SHOWING SECONDARY REACTION UPON THE PRIMARY AS THE LINE RESISTANCE IS VARIED.

Fig. 15 illustrates the complete constant current diagram for a variation of the line resistance showing the back and primary E. M. F.'s.

The secondary currents and E. M. F's. have been explained. The back E. M. F. OF lies upon a circle MF so that OF is always

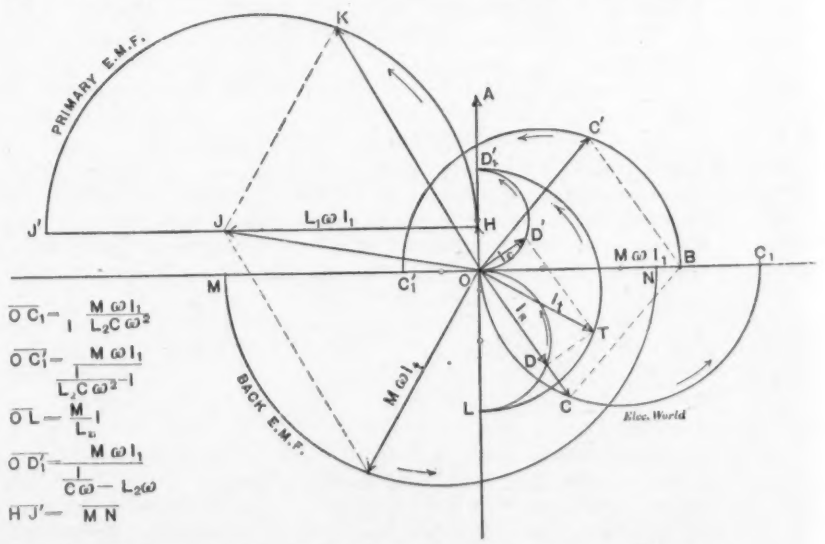


FIG. 15.—TYPICAL CONSTANT PRIMARY CURRENT DIAGRAM WHEN THE TAN $\frac{L_2\,\omega}{r}$ IS LARGE, SHOWING RE-ACTION UPON THE PRIMARY.

ninety degrees behind the transformer current OT and equal to $M\omega$ times OT. This makes the distance OM equal to $L_1\,\omega I_1$ the primary E. M. F. of self-induction. The diameter of the circle has the direction of OM and terminates at a point N so that the distance

$ON = M\omega$ times OD_1'. The primary E. M. F. OK has its locus similar to the back E. M. F. circle with diameter HJ equal to MN. Thus it appears that upon open circuit the primary E. M. F. must be considerably larger than it is when the condenser is absent. It is this extra primary E. M. F. which is used for driving the secondary condenser current upon open line circuit.

Below this typical diagram, Fig. 15, there are to be found the expressions for the principal lines and angles which are easily derived from the figures from which this one is constructed.

The more common case where the primary is supplied with a constant potential still remains to be considered. Such diagrams may be constructed directly from the constant current diagrams just discussed. It is considered unnecessary to draw them here, inasmuch as the methods for constructing constant potential from constant current diagrams has been fully given in previous papers. Furthermore, it is not necessary to actually construct a constant potential diagram to properly understand the problem, for, after a little experience with these diagrams one may see the effects certain changes would produce in them without stopping to go through the details of the construction.

The Franklin Institute John Scott Medal.

The Franklin Institute has awarded the John Scott Legacy premium and medal to Clement Payen, the inventor of the chloride storage battery, on the report of its Committee on Science and Arts. The report states that the sub-committee appointed to conduct the investigation had the battery under careful consideration for a number of months, and investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells were in possession of the committee, and were placed upon a regular working circuit under the control of one of the committee's members, where they were subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured. The results of this examination led to the opinion that this battery embodies certain features of construction which, the committee finds, prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries.

After recapitulating the principles of storage batteries in general and comparing the features of different ones, the committee reports that their investigations confirm the correctness of the claim that the construction of the chloride plate is such that disintegration is far less liable to occur than in the usual form. In conclusion the report states that, believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor.

Fly Wheel Accidents in Power-Houses.

To the Editor of The Electrical World:

Sir:—The increasing number of fly wheel accidents in electric power-houses, particularly those supplying power to railways, has led me to believe that the following may be the cause of many such accidents which have not been otherwise explained.

There are two conditions found in stations: First, where a single dynamo supplies one or more circuits; second, where a number of dynamos running in parallel supply one or more circuits. In the first case, suppose a short circuit on the line to occur, in which case the machine circuit breaker immediately breaks circuit and all the load is removed from the engine. If the short circuit has been caused by the contact of a broken trolley wire with a rail, or any similar cause, it still exists, so far as the line is concerned, after the machine circuit has been broken. Nothing is known, however, in the power-house of the conditions of the line, and the circuit breaker is immediately closed by the attendant. The effect of this is to throw on the engine an instantaneous load much greater than the maximum for which the engine was designed, the load being due to the number of amperes at the machine voltage which would pass over the short circuit. The circuit would, of course, be immediately broken, but not before the engine had received the full impact due to the instantaneous load.

In the second case, suppose one of the dynamos to be overloaded, due to maintaining too large a voltage or for any other reason; the circuit is thereby broken and the engine unloaded, its speed being thereby accelerated somewhat even with the best of governors, and the voltage therefore raised still more. If now the circuit breaker is closed, the machine will be subjected to a still greater load than that which caused the circuit to be broken before. Thus again the engine would be subjected to an instantaneous load greater than that for which it was designed. The preceding are said to be the conditions which existed at a recent power-house accident not far from New York, and the result was the wrecking of the engine and destruction of part of the power-house.

Thus in either case, by the closing of the circuit breaker the engine may have thrown on it with the suddenness of the blow of a hammer, a load of much greater than the maximum for which it was designed. It appears to me that under such conditions the destruction of the engine would be inevitable, and I write to ask the opinion of engineers on this important subject.

Kingston, N. Y. T. C. COVKENDALL.

Distribution with Equalization of P. D.

To the Editor of The Electrical World:

Sir:—I shall be very glad indeed if you will permit me to submit through your columns a few remarks which I think are needful to remove an erroneous impression that seems to have obtained regarding the aim and purport of the paper which I had the privilege of reading at the Electrical Convention in Montreal last week, and to which casual reference was made in your issue dated September 29.

What I endeavored to call attention to is the fact that we can so dispose the quantity of copper that is required for a single circuit two-wire system, in such a way that the potential difference between the mains will be the same at all points of the system; and this without increasing the drop or total amount of energy consumed in the distribution.

In applying the same principle to the three-wire system, I endeavored to show that an increase in the total quantity of copper would be called for, but the economy of adopting the plan even at that cost would be a more than adequate offset.

Now there is an important distinction between this purpose and that which your reference to the matter represents was had in view. The saving that these plans would effect has, where a given current is considered, no direct reference to the volume (that is, the *quantity*) of material composing the circuits; it is incidentally referable to the manner of utilizing the material, as, instead of handling a given number of groups of consumers in separate circuits with a view to some degree of uniformity in the supply, we can take them *en masse* and have thus only to calculate for the maximum percentage of demand on the mains. This is surely a very important consideration and ought no longer to be overlooked.

The expedient suggested in your note of reference as to putting a wire across from the terminals of the sources of current was adopted by a prior inventor of the method, as I took occasion to point out; and if looked at carefully, it will be seen that with such a cross wire, the virtue of the whole scheme is nullified, as then the lamps nearest the sources will get more current than those farthest away—the very thing that it is sought to obviate.

Ottawa, Cnt. D. H. KEELEY.

Electric Whirls.

To the Editor of The Electrical World:

Sir:—Referring to a notice in The Digest of The Electrical World dated September 29, reprinted from a French Academy paper by M. Zenger, I would like to state something about similar experiments, conducted some years ago by myself, and which might prove interesting for some readers of your esteemed paper.

These experiments were conducted with the view of ascertaining the purifying effects of an electrical discharge on air and different vapors. The apparatus consisted of a big, well-corked glass bottle, inside of which two brass combs were fastened exactly opposite to each other. The distance between these combs could be varied. If the current from an influence machine was discharged through the combs, the vapors enclosed in the bottle would at once start whirling around vehemently. The most beautiful effects I obtained in operating with tobacco smoke. The whirls showed exactly the same shape as Mr. Zenger describes, the spires enlarging toward the middle. After a short time, the smoke would disappear entirely, leaving only a precipitate of nicotine on the walls and of ashes on the bottom of the bottle. R. T. ESCHER.

New York, N. Y.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Currents in Open Circuits, Dielectrics and Electrolytes.—An Academy paper by Mr. Nicolaieff on two methods for studying currents in open circuits and the currents of displacement in dielectrics and electrolytes, is given in abstract in "L'Elec.," Sept. 15. He concludes, among other things, that electrolytes act like perfect dielectrics and that they therefore do not conduct like metals; a note at the end states that the results are deduced from too few experiments to enable them to be accepted as indisputable.

Alternating Currents in a Divided Circuit.—In an article by Mr. Russel in the Lond. "Elec.," Sept. 21, he discusses the problem of finding the alternating currents in a divided circuit when the mutual induction is appreciable; he discusses it graphically and algebraically, showing that the former is the best way of solving the problems.

Action of Alternating Currents on Dielectrics.—The Lond. "Elec. Rev.," Sept. 21, replies editorially to the note of Mr. Addenbrooke abstracted in the Digest last week, but gives nothing new.

Fluorescence a Phenomenon of Ionic Origin.—Recent investigations made by Mr. Buckingham appear to support the belief that the phenomenon known as fluorescence is of ionic origin; a large number of observations were made and in every case the observed results were as expected. The paper is published in the "Zeit. feur Phys. Chem.," vol. 14, p. 109, and is very briefly abstracted in the Lond. "Elec. Rev.," Sept. 21.

Migration of Ions.—The Lond. "Elec. Rev.," Sept. 21, abstracts briefly and recommends a paper by Mr. Bredig in the "Zeit. feur Phys. Chem.," vol. 13, p. 191.

MAGNETISM.

Magnetic Lag.—A paper by Mr. Dechant on the magnetic lag in iron cores due to periodic alternating magnetizing forces, is published in the "Zeit. feur Elek.," Sept. 15; he discusses it analytically and graphically, giving a simple graphical solution. He shows that two periodical alternating magnetizing forces of a certain phase difference, when acting on different parts of an iron bar, develop magnetic waves of varying amplitude, which travel along the iron but with relatively small velocity; the latter is found when the distance between the places where the forces act are divided by the phase difference; he proves this experimentally. He also shows that the diminution in the intensity of the magnetization along the bar is an essential condition for the existence of this lag. (Another paper on this subject, by the same author, was abstracted in the Digest, July 28.)

Magnetic Constants of Soft Iron.—A paper by Dr. Froelich is published in the "Elek. Zeit, " Sept. 20; it is supplementary to his other recent paper (see Digest, Aug. 4), in which he endeavors to establish the law of the magnetization of iron; he deduces the constants occurring in his law, from a number of different observed results with different irons, and shows how the calculated and the observed values agree; he shows that good magnetic experimental data can always be represented by a formula with close agreement; the various coefficients determined for a number of different irons differ very considerably from each other, and those obtained from one set can therefore not be applied to another. He discusses the various methods for making measurements and concludes that there is no doubt that the best method for obtaining the magnetization curve is by means of a closed ring of iron. The present paper also answers the recent criticism of Mr. Culmann (see Digest, Sept. 1).

Tubular Magnets.—Mr. Boult, in the Lond. "Elec. Rev.," Sept. 21, states that in designing a special apparatus in which a permanent magnet was to be alternately operative and inactive, he decided upon a straight tubuler magnet with a movable iron core; as the side pull is balanced, friction is reduced to a minimum and the end pull is very slight; by moving this core in and out the pull of the magnet becomes inactive or active respectively. He asks for an explanation for the way in which the return lines of force in this apparatus are able to cut through the steel without destroying its magnetism; he offers the explanation that they cut in or out of the tube gradually throughout the time occupied in the movement of the core; the amount of demagnetizing force at any instant is therefore small as compared with the permanent magnetization.

Magnetic Researches.—A paper by by Mr. Fromme from the "Wied. Ann.," vol. 53, page 236, on the self-induction and electrostatic capacity of coils and their influence on magnetic phenomena, is abstracted in the "Elek. Zeit.," Sept. 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Construction of Resistances.—An Institution paper by Mr. Morris (read in March) is reprinted in the Lond. "Elec.," Sept. 21. He divides resistances into those which have a fixed value, for carrying inappreciably small currents, and those for absorbing power; for the former there are only four alloys, platinum silver, German silver, platinoid and manganin. A table is given containing the composition, the specific resistance and the temperature coefficient for these, as also for other materials used, including iron, carbon, sulphuric acid and sulphate of zinc; a diagram is given showing the specific resistance as a function of the temperature for each of these materials from zero to 200 degrees, based largely on the researches of Dewar and Fleming. He gives the following general rule, that roughly the specific resistance (in ohms per cubic centimeter) divided by 1,000 is equal to the resistance in ohms of a mile of No. 17 B. W. G. wire of that material, or it is the resistance in ohms of 100 yards of No. 28 wire. Manganese steel, containing 12 per cent. of manganese, has by far the largest specific resistance of any substance available in the form of wires, excepting "Kruppin" (see Digest, Jan. 6 and Feb. 3), whose specific resistance is 83,000, the temperature coefficient being about the same; manganin, which is used largely on the Continent, has little or no temperature coefficient; it contains about 84 per cent. of copper, 12 per cent. of manganese and 4 per cent. of nickel; it seems to have a maximum resistance almost exactly at ordinary temperatures, but slight variations in its position seem to shift this point considerably. Iron wire doubles its resistance by the time it gets fairly hot, while with carbon, in the form of incandescent lamps, the resistance while hot is about one-half that when cold; the temperature coefficient of the liquids used is much greater, being for a saturated solution of sulphate of zinc equal to a diminution of 2.3 per cent. for a rise of one degree C. He discusses standards and shows how they are constructed, describing the modified form of Dr. Fleming, in which the coil is contained in a shallow metallic ring of brass, so as to take the surrounding temperature rapidly and also to rapidly get rid of the heat generated by the current. German silver, he states, becomes rotten in the course of time, owing to the crystallization of the zinc; manganin is unfortunately liable to change owing to the oxidation of the manganese, leaving, as the only practical alloy, one made of one part of platinum and two parts of silver.

Copper and German Silver Coils in d'Arsonval Galvanometers.—In an article by Mr. Meylan in "L'Elec.," Sept. 15, he discusses, in a practical manner, the relative merits of galvanometers of the d'Arsonval type, in which a coil moves in an intense magnetic field, first when the coil is made of copper and then when it is made of German silver. He considers the case of a wide range instrument in which the galvanometer is shunted and at the same time in series with a resistance, the variations of both of which give it a wide range; unless the coil and the shunt are made of the same metal the temperature coefficients will introduce errors, which may, with a German silver shunt and copper coil, become 3.6 per cent. for 10 degrees difference of temperature; such shunts should therefore be made of the same metal. He gives the various constants for an assumed range, first when the coils are copper and then when they are German silver, and concludes that the latter method, which is more general and more precise, requires more attention on the part of the operator and can therefore not be put into every one's hands; having lately had occasion to equip a complete laboratory he concluded to adopt the first method for the ordinary measurements which can be made by any one, while he reserved the second method for an apparatus of precision for standardizing.

Hot Wire Instruments.—A recent form made by Hartmann & Braun for amperes and for volts, is illustrated in the "Elek. Zeit.," Sept. 20; the deflection of the middle of a short stretched wire is used to deflect the needle; it is made aperiodic by magnetic damping, a small disk of aluminum being moved between the poles of a powerful permanent magnet.

Recording Instruments.—A new form made by Messrs. Nalder & Harrison is illustrated and described in the Lond. "Elec. Eng.," Sept. 21; the instrument is made on the d'Arsonval type, and it is claimed that it records variations of less than 0.3 per cent.; the record is made on the usual revolving drum; they are made for amperes or volts.

Phase Meter.—A translation of the article abstracted in the Digest, July 21, describing the instrument of Mr. Dobrowolsky, is published in the Lond. "Elec.," Sept. 21.

Symbols and Abbreviations.—The Lond. "Elec. Rev.," Sept. 21, reprints the table published in The Electrical World, Aug. 25, together with modifications suggested by Prof. Jamiesen; these are briefly as follows: For angles the Greek letter α is too much like the letter a; he prefers β and θ; he recommends the use of H. P. for horse-power, I. H. P., B. H. P., and E. H. P. for indicated, brake and electrical horse-power respectively; he thinks K is not suitable for moment of inertia and claims that there is no need of any single letter as it is sufficiently well expressed by the product ML^2; K should be reserved for "kapacity," which he suggests spelling with a k when used in a truly electrical sense to distinguish it from capacity as used in many other senses, like the capacity of a dynamo; instead of the French script letters for the magnetic units, which he says are difficult to write on paper and the blackboard and are not usually in printer's fonts, he greatly prefers the Clarendon or block or boldfaced type; for reluctivity he prefers writing the reciprocal of permeability, as the Greek letter, ν, is easily confounded with v; he objects to the use of U and u, recommending v for volts or P. D. for potential difference, instead; he strongly objects to the use of I and i for current, recommending C and c; for the earth's field he suggests the italic H as distinguished from the boldfaced type for local fields; for electric power as distinguished from mechanical power, he prefers W_P or P_W, the former meaning watt-power and the latter power in watts, which he says is the true and only meaning; he thinks there is no use of the letters G and g for reluctance, since the reciprocal of K is quite sufficient; the letter G should be reserved for gauss, when this term is adopted; for self-induction he suggests L_s and for mutual induction L_m; in place of the word "per" he suggests the sign / in preference to a colon; a small capital A should be used for ampere since small capital V is used for volt, and he suggests using the accepted ω for ohm and Ω for megohm; instead of mho he would simply use the reciprocal of ohm; he thinks that the terms gauss, weber, gilbert and oersted are neither well chosen nor necessary and "if the necessity should arise" for words to express the quantities they should be very carefully discussed together with others "which are more suggestive of the expressions which they are to indicate;" he suggests the use of Greek letters for the dyne and the erg.

Alternating Current Relay.—A relay invented by Dr. Aron is described and illustrated in the "Elek. Anz.," Sept. 10; it is intended to overcome the difficulties encountered in such relays and consists briefly of a solid copper secondary coil of a small tranformer, the coil being pivoted so as to move and thereby opened and closed a contact; the coil is also situated between the poles of another electro-magnet, around which the main current passes; the first coil induces a current in the copper ring which, being under the influence of the other magnet, produces a deflecting torque.

Photometry.—In an article on "A New Photometry" in the "Elek. Tech.," Sept. 15, a paper of Mr. Crova is abstracted (although not so stated, this paper is believed to be the one read at the Congress of 1889 in Paris).

Definition.—A definition of electro-motive force by Mr. John Sprague is given in the correspondence column of the Lond. "Elec. Eng." Sept. 21.

ARC AND INCANDESCENT LIGHTS.

Arc Lamp with Two Arcs.—The Money-Nash lamp is described and illustrated in the Lond. "Elec. Rev.," Sept. 21; there are two arcs in series, controlled by one set of mechanism and it is intended to replace the usual wasteful resistance for reducing the voltage to 45 when only one pair of carbons is used (presumably from an incandescent light circuit of 100 volts); both arcs burn at the same time and it is claimed that with six amperes the light is equal to an ordinary lamp taking ten amperes, representing a saving of 6½ cents per hour to a consumer using single lamps from a 100-volt circuit, at the rate of 16 cents per kilowatt-hour, or twice the amount of light at no extra charge for current; they are adapted to both alternating and continuous currents; they state there was a variation of two volts while feeding, which the editors think is too much.

Alternating Arc.—Mr. Brown, in a communication to the Lond. "Elec.," Sept. 21, states that he found experimentally that the band of violet light of the usual alternating arc lamp could be gotten rid of and the efficiency increased by using a solid carbon for the top and a cored carbon for the bottom, in place of two-cored carbons as usually employed; the arc is then shortened to its normal length and is claimed to have an increased temperature with a whiter light. In an editorial the belief is expressed that this is not a complete cure.

Lighting of Workshops.—A note in the "Zeit. feur Elek.," Sept. 15, calls attention to the advantages of the inverted arc lamp; a 10-ampere 45.5-volt lamp gives a maximum of 2,070, and a mean spherical of 750-cp of which 640 are below the horizontal plane through the arc; by means of the inverted arc and a reflector almost the whole of this spherical intensity can be produced below the lamp and it will be then equal to about 46 incandescent lamps of 16-cp, which at 50 watts require 2,300, while the arc lamp requires only 455, representing a saving of about 400 per cent.

Differential Arc Lamp.—A new form is illustrated and described in the "Elek. Anz.," Sept. 16.

Reducing the Candle-power of Incandescent Lamps.—In a communication to the Lond. "Elec.," Sept. 21, Mr. Sharp gives some further information about the system which was recently ridiculed in the English journals. The method which he now describes is one in which a cluster of lamps is coupled by means of a switch into groups in which the lamps are connected in series and multiple in different ways; in case one 16-cp lamp is required he uses two lamps of 8-cp, connecting them in parallel for 16-cp and in series for a lower candle power; by this means he claims to obtain a "plesant mellow light" with a great saving of current.

Mercury Poisoning.—The "Elek. Anz.," Sept. 20, mentions a recent paper by Dr. Donath, calling attention to the mercury poisoning in incandescent lamp factories, to avoid which he recommends large rooms, the introduction of ventilators, cleanliness of the workmen, the use of the Sprengel pump in preference to the Toepler, as it requires only one-tenth of the amount of mercury and is less easily broken; mechanical air pumps are of course still better; the use of mercury pumps driven by air pressure is also recommended as they are much less likely to break.

Candle-power of Incandescent Lamps.—Another article from Dr. Fleming's forthcoming book is published in the Lond. "Elec.," Sept. 21; it contains nothing new. He gives curves for the variation of the candle power, for the current, the voltage, the watts and the watts per candle; the candle power varies approximately as the fifth or sixth power of the current; it varies also very nearly as the cube of the total power in watts.

Incandescent Lamp Tests.—The results of some tests giving the candle-power and current at a constant voltage for a series of 500 hours for five different lamps are published in the "Elek. Zeit.," Sept. 20; the lamps were made by a German firm.

General Theory of the Incandescent Lamp.—A paper by Mr. Weber read at the Frankfort Congress (1891?) is reprinted from the "Physical Review" in the Lond. "Elec. Eng.," Sept. 21.

ELECTRIC RAILWAYS.

Liverpool Overhead Railway.—The discussion of the papers of Messrs. Greathead, Fox and Parker (see Digest last week) is concluded in the Lond. "Elec.," Sept. 21; the present portion is devoted almost entirely to the electrical features, and contains much that is of interest; the following are a few extracts from it. Mr. Cottrell, in referring to the commutators, states that they now run 9,500 miles and one of them 16,000 miles without "skimming" (presumably meaning "turning down"); the carbon brushes at first cost about $30 per week, but have now been reduced to $10.20, and it is hoped shortly to get it to $5 per week; flat carbon brushes are used; round carbons, as also copper gauze, have been tried, but without success. The railway stations are lighted by two sets of lamps, one in series from the main conductor and the other in parallel from the accumulators; the automatic signals have answered admirably and effected a very considerable saving in the working expenses; with coal at $2.06 per ton the haulage was 6.96 cents per train mile and at $1.50 per ton it would be only 6.68, including all wages, stores, etc. Mr. Alexander Siemens referred to the subject of motors on the cars as distinguished from separate locomotives, and said that the choice had to be decided in each case on its particular merits, as it was not possible to say that either one was universally the best; on the Liverpool line there were only two cars to a train and the arrangements for working the motors from one end or the other were comparatively simple, but on a railway with more cars the question of the switching arrangement was very serious; the multiplication of small motors on the cars also meant a serious increase in their cost; comparisons are made with the City and South London road and the Liverpool road; in the former he shows that one locomotive ran about 40,000 miles and another 50,000 without requiring any considerable repairs, and he believes that there is no steam locomotive which has such a record; one of them had run with the same pair of brushes since it was delivered. Regarding the loss of energy at starting, he suggests that a very good way was to put a motor generator on the locomotive, using a high pressure current of 2,000 volts, and putting the motors directly on the axles, stating that the extra cost was not very much more than in the present plan, but it introduced complications, and the present arrangement, though wasting more energy, was preferable because it was simpler. The average watts per train mile in the City and South London line were 21,320, while in the Liverpool line, with trains of about the same weight, it was 32,650; the great point in electrical railways was to have frequent service, and he believes it perfectly impossible to introduce electric traction satisfactorily on railways on which there are only three or four trains a day. Mr. Blackwell stated that an underground conductor in a slotted conduit can be used satisfactorily, but was very much more expensive, as it cost approximately $35,000 a mile for a more or less efficient system, while it cost about $3,500 a mile for a first-class practicable overhead conductor system; the reason why the overhead conductor had been adopted in the United States was simply a financial and practical one; he believes that the objections urged against overhead wire were much less important than those of a system involving interference with the street service and the maintenance of an open slot. Mr. Sellon referred to the South Staffordshire railway and the side trolley system adopted there, which dispenses with span or pull-over wires. Mr. McDonnell compared the Liverpool with the Metropolitan steam road in London, stating that the latter is not in any way adapted

for the electric system, as in some parts there was a half hour service in which the electric system, he claims, would certainly not be economical, as the latter is adapted to light trains run very frequently. Mr. Beaumont discussed the subject of starting the train, stating that he had shown on a previous occasion that it would be possible, by mechanical means, to avoid taking more power than was necessary for keeping the train in motion; he believes that there is no electrical method known for surmounting that difficulty. Dr. E. Hopkinson took exception to a number of statements; the efficiency between the indicated horse-power in the steam cylinders and the electric horse-power delivered from the terminals of the dynamo, was given as 88 per cent.; this he was not at all prepared to accept; the best results obtained by the Willans engine has never exceeded 87 per cent., using direct driving, while in the present case rope driving was used; he works out that the loss in engine friction, ropes and dynamos, and by electrical friction of various kinds in the armature, was only 10 per cent., if the total efficiency is 88, and such a result was absolutely impossible. He makes some deductions from the figures given and finds that the average tractive force per ton of train was 55 lbs., which he calls extraordinary; in the City and South London line it was 16 lbs. per ton of train of practically the same weight and working under the same conditions; from some deductions he finds that the tractive force in the Liverpool line was 35 lbs. per ton, that is the force required to overcome the resistance only and not to give the train acceleration; this was more than double the same figure for the City and South London line and also greatly in excess of common experience. The total cost of traction on the Liverpool line, including current for signaling and lighting, was 7.95 cents per mile, with coal at $1.10 per ton, while on the City and South London line, including current for lighting, but not signaling, it was 12.44 cents per train mile, with coal at about three times that price and higher rates of wages; the repairs on the lines were 1.9 and 1.4 cents per train mile respectively; many of the locomotives had now run over 100,000 miles, and the cost of repairs during the last 30,000 did not exceed 0.06 cents per train mile. Mr. Parker, in replying, stated that the trains on the Liverpool line required less energy at starting than when in motion, the motors being put in series for starting and afterwards in parallel; in comparisons with the City and South London line the trains of the Liverpool line were 12 per cent. heavier, ran at 24 per cent. greater average speed, and made about 50 per cent. more stops; comparisons were therefore misleading unless these features were considered; he believes that there is no difficulty in running the Metropolitan (London) trains with the same proportionate economy as the trains on the Liverpool line; he believes that the depreciation of the dynamos and motors will be found to be less than with steam engines. On the City and South London line the tractive force for 150 amperes was 50 lbs. per ton of train, while on the Liverpool line it was 120 lbs. for the same current; he believes that Dr. Hopkinson's figures do not apply when the motors are constantly starting and stopping; on the Liverpool line during January and February each train took an average of 36.5 electrical hp, while on the City and South London line it was 33. Mr. Aspinwall claimed that the engine mile was the only figure which could be applied in order to make comparisons upon a proper basis; on this basis one of the largest steam railways in Great Britain was able to run at slightly more than 12 cents per engine mile, including maintenance and renewals of its stock, while the 8 cents for the Liverpool line, did not include renewals of stock; the cost of running the Liverpool line, after making certain reductions, is about equivalent to that of any ordinary light steam railway; there was no first-class railway in England, which consumed more than an average of 41 lbs. of coal per engine mile; he cites a case in which it was 16 lbs.; he believes the Liverpool line could be run with steam locomotives for slightly less than 12 cents per mile, including maintenance and depreciation of locomotives. Mr. Crompton believed that the efficiency of 88 per cent., mentioned above, could not possibly be obtained under the circumstances.

Sectional Contact Rail System at Lyons.—"L'Elec.," Sept. 15, publishes at some length and with the aid of a number of illustrations, the first part of a description of the Claret and Willemier system, which has been running for five months in the city of Lyons. The power is generated by a gas engine using a cheap form of gas made on the premises; the coal consumption is said to be 1.1 lbs. per horse-power hour for a 100 hp engine. The current for the car is taken from strips of iron on the pavement midway between the tracks, about 9 ft. long and about 10 ft. apart from each other; the car touches one before leaving the other; these strips are connected to the underground circuit only while the car is over them; the feeder is located under the sidewalk, and is connected to the various sections through a somewhat complicated apparatus called a distributor, which is placed at about every 300 ft. along the line and provides for the connections of 10 to 18 sections; this distributor is described in detail and appears to consist of series of contacts, one connected to each section, the contact maker being operated by the force of a weight suspended on a drum, like in a clock, and actuated by an electromagnetic device; this latter appears to be operated by a current from the previous section, which is led by means of the car through the next section which is to become active; the article is to be continued.

Suspended Railway System.—The Langen system is described and illustrated in the "Elek. Anz.," Sept. 20; the cars are suspended from rails secured to an overhead structure.

Gas Traction.—An editorial in the Lond. "Elec.," Sept. 21, states that gas traction has been adopted on a road at Blackpool in which a syndicate is to run it for seven years at a sum of 9 cents per car mile, with a minimum of 163,000 car miles per annum.

Locomotives.—Referring to the electric locomotives recently made in this country, in which the tractive force of 373 lbs. per ton of locomotive was obtained, the Lond. "Elec.," Sept. 21, states that on the Liverpool Overhead Railway a tractive force of 750 lbs. per ton (of train?) is obtained, and 234 lbs. per ton of steam engines of the London district underground railway.

Heating Cars.—According to the Lond. "Elec.," Sept. 1, the cars on the Saleve electric track railway are heated electrically; the resistances are made of galvanized iron wire 1.5 mm in diameter, and a total length in the two heaters of 500 meters; the two heaters are connected in series, requiring a current of 15 amperes, equivalent to 10 hp; the temperature of the wire reaches 100° C., and even in the severest weather the car is heated to 15° or 20° C. in 10 to 15 minutes.

Dresden.—An electric line near this city with some features differing from those of lines in this country, is described and illustrated in the "Elek. Echo.," Sept. 2.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Regulating the Phase in Alternating Current Circuits.—In a paper by Mr. Imhoff in the "Elek. Zeit.," Sept. 20, he calls attention to a recent statement by Prof. S. P. Thompson (see Electrical World, Sept. 1, p. 208) in which it was shown that a synchronous alternating current motor can, by regulating the excitation of its field, act either as a choking coil or as a condenser, and can therefore be used to regulate the phase and to compensate for phase differences in long lines or in circuits containing motors. As this involves extra machinery, Mr. Imhoff suggests the following simple method, which requires no extra machinery. The continuous current exciter of the alternators, besides having the usual commutator, is provided with two slide ring contacts from which an alternating current may be obtained; when the alternator and exciter are running properly the alternating current circuit of the exciter is connected to the alternating current mains, due care being of course taken to first establish synchronism, the belt or other device for driving the exciter being at the same time thrown off; the exciter will then run as a synchronous motor driven by the current from the mains; any phase differences between the two or more alternators are then adjusted by resistances in the circuit of their respective fields, and any phase differences between the current and the voltage in the mains are adjusted by means of a resistance in the field circuit of the exciter; the alternators can then always be made to run under the most favorable conditions; the great advantages which phase regulators have in the economical running and in the reduction of the cost of an installation, will, he believes, lead to their general adoption.

Advantages of Alternating Currents.—In the Lond. "Elec. Rev.," Sept. 21, Mr. Appleyard contributes to the discussion started by Prof. Thompson's statement, more particularly to the statement made by that Journal, abstracted in the Digest Sept. 15 and 22. He states that reversing the current in cable testing for breaking down faults, is not to be considered as an evidence of the effect of an alternating voltage upon a cable, such an assumption being absurd as it ignores the time element. The statement that the stressing pressure is the maximum value, as distinguished from the mean value, he states, is opposed to experience, and the stress on a cable in an alternating system can never reach a sine curve or sawtooth tops as long as dielectrics absorb the current. In replying to this the editors state that they had reference to the breaking through of a weak spot in the insulation so as to make a puncture; they claim that reversing the battery current repeatedly has always been used for accelerating the breaking down of high resistance faults.

Rectifiers.—In the English journals Mr. Ferranti replies to a recent statement by Mr. Walker in which it was claimed that rectifiers were mere laboratory toys; Mr. Ferranti in a letter published in the Lond. "Elec. Eng.," Sept. 21, states that the arc lighting by means of rectifiers at Portsmouth has proved to be the most complete success; he cites a number of plants for which rectifiers have been ordered and claims that there are now no consulting engineers of any importance who are not ready to furnish rectifiers for street lighting.

Rules and Regulations for Installations.—In the "Elek. Zeit.," Sept. 20, Dr. Gusinde suggests a series of rules and regulations for electrical installations. At the end he gives an interesting set of simple conventional signs for representing the different parts of an installation; an incandescent lamp, for instance, is represented by a cross like a multiplication sign, a figure attached representing the candle-power and the addition of a few diagrammatic lines shows whether the socket is to include a key, whether the lamp is on the horizontal or vertical bracket, etc.

Temesvar.—A description of the installation in this city is published in the "Zeit. feur Elek.," Sept. 15. This is said to be the first city on the Continent of Europe whose streets were lighted throughout with electric light; the installation was opened in 1884.

Statistics.—Some statistics for installation in Austria for 1893 are published in the "Zeit. feur Elek.," Sept. 15.

WIRES, WIRING AND CONDUITS.

Conduits.—A recent gas explosion in France is discussed in the Lond. "Elec.," Sept. 21, and it is stated that as a result of the explosion the following regulations were agreed upon: no work to be done by either the gas or electric companies in the neighborhood of the mains of the

other without due notice; the electric light company is to substitute earthenware castings for those of cast iron for their branch services; and branch gas service pipes in the neighborhood of electric light mains are to be laid in wooden boxes filled with natural bitumen.

Graphical Wiring Table.—The Howard table is briefly described in the Lond. "Elec. Eng.," Sept. 21; a special feature is that a logorithmic scale is used, by means of which diagonal lines are made parallel instead of being radial, thus enabling all parts of the table to be deciphered with equal ease.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephony.—It is said that Madrid and Paris will shortly be connected by a telephone line.

Telephone System in the Arlberg Tunnel.—A description of this system is published in the "Zeit. feur Elek.," Sept. 15.

Pacific Cable.—An article is contained in the Lond. "Elec. Rev.," and "Elec. Eng.," Sept. 21.

Statistics.—Some telegraph and telephone statistics for Austria for the year 1893 are given in the "Zeit. feur Elek.," Sept. 15.

ELECTRO-CHEMISTRY.

Chlorine and Soda.—The Castner process is referred to in the Lond. "Elec. Eng.," Sept. 21; it is said to differ radically from the other processes, its essential feature being the use of a mercury diaphragm (see Digest, Oct. 7, 1893); the process is continuous and it is claimed that the electrical efficiency is 88.9 per cent., also that no hypochlorides are produced, their production being a defect in other kindred processes; an installation at Oldbury has been in regular operation for over six weeks, and it was found that a cell six by three feet and six inches deep decomposes 56.5 lbs. of salt daily, producing 38.5 lbs. of chlorine in 24 hours, with an expenditure of 3.5 indicated hp; the caustic solution produced contains 20 per cent. of caustic soda and yields a solid caustic of 99.5 per cent. purity, while the chlorine is of 95 to 97 per cent. purity; the plant contains 30 cells; it is claimed that a number of experts have expressed a favorable opinion of the process.

Bleach.—The Gebauer-Knoefler process for the electrolytic manufacture of bleach is briefly described in the "Zeit. feur Elek.," Sept. 15.

Chlorate of Potash.—The electrolytic process of Messrs. Hausermann & Naschold for its preparation, is briefly described in the "Elek. Anz.," Sept. 13, taken from the "Chem. Zeit.," p. 857.

Electro-zincing.—The Lond. "Elec. Rev.," Sept. 12, gives briefly some further information regarding the Cowper-Coles process (see Digest, February 24 and March 31) together with some illustrations of the apparatus. Most authorities are said to recommend a current of 18 to 20 amperes per square foot and a solution of zinc sulphate, acetate or chloride; electrolytes made by adding potash or soda to a zinc salt are found to be unworkable on account of the formation of an insoluble zinc oxide on the surface of the anode; deposits from acid solutions are of a transitory nature and the durability is not as great as with hot galvanizing, as the deposit is porous and retains some of the acid salts; the Cowper-Coles process is said to overcome some of these difficulties; but how, is not explained. The articles are first treated in a "potash boil" at 200 degrees F.; they are then placed in a pickling tank made of a weak solution of sulphuric acid and water kept in circulation, then in a washing tank, after which they are placed in the zinc bath; the current density is about 50 amperes per square foot, the total output of the dynamo being 2,500 amperes at 5 volts; a detailed account of a plant now being erected with a bath capacity of 14,000 gallons is promised. In another description, in "L'Elec.," Sept. 15, it is stated that the electrolyte used is like that in the ordinary baths, except that oxide of zinc is added, the presence of which, according to the inventor, aids the electrolytic action and overcomes the difficulties encountered in the other processes.

Chemical Theory of Accumulators.—An article by Mr. Wade is begun in the Lond. "Elec.," Sept. 21. He discusses the history of accumulators and shows that there is practically no difference between a storage and a primary battery; regarding the lead cell he states that the amount of energy that one pound of lead would generate if wholly converted into lead sulphate could be produced by about ¼ lb. of zinc or iron, or about ⅛ lb. of copper; practically the very property of lead which at present constitutes its superiority to other metals, that is, the insolubility of its sulphate, at the same time limits its efficiency by reducing the energy obtainable to a small fraction of the theoretically possible amount; the active material requires a grid and under the best conditions not more than half the active material is really acted upon, the result being that not more than 5 to 15 per cent. of the total weight of electrodes is usefully employed.

Accumulator Plate.—The "Elek. Anz.," Sept. 9, contains an illustrated description of a plate, the main frame of which is made of some inert material, such as hard copper enclosed in lead.

Velvo Carbon Battery.—The primary battery mentioned in the Digest last week in connection with the launch "Velvoca," is briefly described in the Lond. "Elec. Rev.," Sept. 21. It is a Smee cell with an improved carbon covered with fine filaments of carbon, from which the hydrogen readily escapes; these electrodes consist of Lacombe arc light rods, nine mm in diameter, one foot long with velveteen cemented upon them and afterwards carbonized at a high temperature; when used for a depolarizing solution there are similar rods, but covered with deep-pile corduroy instead of velveteen; they are made for coring, but are uncored, a No. 28 silver wire 2 ins. long being wedged into the core hole by means of a celluloid wire wedge in order to form a good connection when entirely under the surface of dilute sulphuric acid; when the connection is above the liquid a platinum wire is used, protected with ozokerit wax; the silver connection costs ¼ cent, and the platinum connection 4 cents; the spent solution is removed by means of an ebonite pump and the fresh solution is led to the cells through leaden pipes; the cells are filled or emptied in ten minutes and the zincs are replaced in half an hour (but it does not say for what size of battery); the E. M. F. remains fairly steady at 0.5 volt until the soluton falls considerably in strength; no form of Smee battery can have even a moderate efficiency; what is aimed at, however, is not efficiency but simplicity, absence of porous pots, no corrodable connections, no depolarizer, no fumes, etc.; tests by the inventor give an output of 67 watt hours for a consumption of 5¾ oz. of zinc and 1¼ lbs. of acid, equal to 5 lbs. of zinc and 18 lbs. of acid per kilowatt-hour; the zinc costs 10 cents per pound and the acid one cent, so that at a discharge of 19 amperes the cost is about 70 cents per kilowatt-hour; at a discharge of 60 amperes 6½ lbs. of zinc were consumed per kilowatt-hour, making the cost per kilowatt-hour 80 cents. Prof. Jamieson, in reporting on this cell, states that the carbons are much superior to plain carbons; the silver connections are said to be lighter and cheaper than any other metal known; he obtained a charge of 30 amperes for a seven hour continuous run, with a consumption of zinc of 2¾ lbs. per thousand ampere-hours, and a consumption of sulphuric acid equal to nearly 1½ lbs. per pound of zinc consumed; the cell weighs 17 pounds and gives an output of one watt per pound; weight for weight it yields a greater output than any other primary or secondary battery with which he was acquainted.

Primary Battery.—The Lond. "Elec. Rev.," Sept. 21, discusses very unfavorably the recently published inventions of Mr. Coad, whom it classes as either a knave or a fool.

MISCELLANEOUS.

Treatment in Case of Accident.—A brief set of rules by Dr. Hedley, taken from the "Lancet," is published in the Lond. "Elec. Eng.," Sept. 21, and printed in abstract elsewhere.

Lightning.—A recent case in which a rabbit was killed and had its fur burned off, is discussed in the Lond. "Elec. Eng.," Sept. 1.

Electricity in Agriculture.—Some applications of power in agricultural work are described and illustrated in the "Elek. Echo.," Sept. 15.

Educational.—Another lecture and another section of the examination questions of the City and Guilds Institute, are given in the Lond. "Elec. Eng.," Sept. 21. Some examination questions are also published in London "Electricity," Sept. 14 and 21.

Exhibition of 1900 at Paris.—The Lond. "Elec. Rev.," Sept. 21, publishes some information of interest to intending exhibitors.

Prizes.—A list of the prizes offered by a French Society are published in "L'Elec.," Sept. 15.

Moonlight Tables for November, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of November under his modified form of moonlight schedule.

TABLE NO. 1.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P. M.	2	5.30 A. M.
2	7.20 "	3	5.30 "
3	8.30 "	4	5.30 "
4	9.30 "	5	5.30 "
5	10.30 "	6	5.40 "
6	11.30 "	7	5.40 "
7			
8	12.30 A. M.	8	5.40 A. M.
9	1.40 "	9	5.40 "
10	2.40 "	10	5.40 "
11	3.50 "	11	5.40 "
12	No light.	12	No light.
13	"	13	"
14	5.10 P. M.	14	6.40 P. M.
15	5.10 "	15	7.30 "
16	5.10 "	16	8.40 "
17	5.10 "	17	10.00 "
18	5.10 "	18	11.10 "
19	5.10 "	20	12.20 A. M.
20	5.10 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.00 "
24	5.10 "	25	6.00 "
25	5.10 "	26	6.00 "
26	5.00 "	27	6.00 "
27	5.00 "	28	6.00 "
28	5.00 "	29	6.00 "
29	5.00 "	30	6.00 "
30	5.00 "	1	6.00 "

Total No. of hours, 222.50.

TABLE NO. 2.
Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P. M.	2	5.30 A. M.
2	5.20 "	3	5.30 "
3	5.20 "	4	5.30 "
4	5.20 "	5	5.40 "
5	5.20 "	6	5.40 "
6	5.20 "	7	5.40 "
7	5.20 "	8	5.40 "
8	5.20 "	8	12.00 M.
9	1.40 A. M.	9	5.40 A. M.
9	5.20 P. M.	9	12.00 M.
10	5.20 "	10	"
11	5.20 "	11	"
12	5.20 "	12	"
13	5.20 "	13	"
14	5.10 "	14	"
15	5.10 "	15	"
16	5.10 "	16	"
17	5.10 "	17	"
18	5.10 "	18	"
19	5.10 "	20	12.2 A. M.
20	5.10 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.00 "
24	5.10 "	25	6.00 "
25	5.10 "	26	6.00 "
26	5.00 "	27	6.00 "
27	5.00 "	28	6.00 "
28	5.00 "	29	6.00 "
29	5.00 "	30	6.00 "
30	5.00 "	1	6.00 "

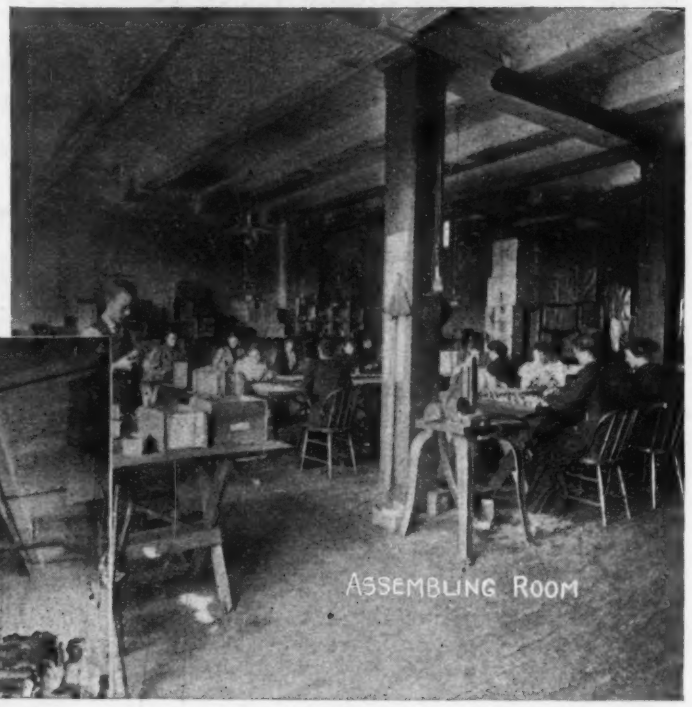
NOTE.—These schedules are made upon sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

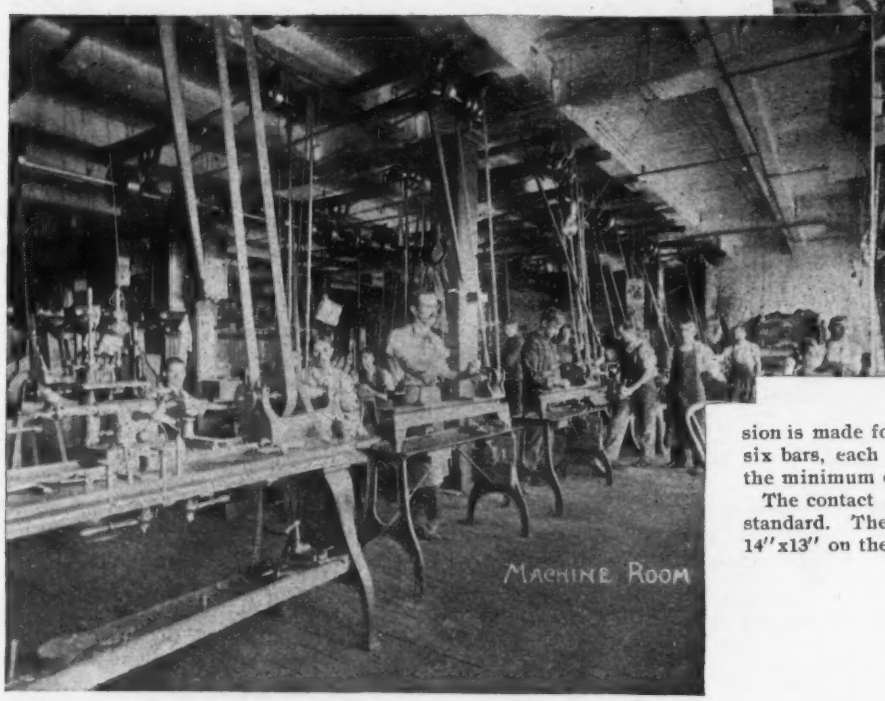
The Iona Manufacturing Company.

Among the factors that go to make up the successive advances in the development of electrical apparatus, the improvements in the smaller detail fittings, although not as noticeable as the larger machinery to the general observer, are quite important, and as a matter of fact claim the attention of some of the most active inventors and manufacturers in the electrical field.

The Iona Manufacturing Company, of Boston, Mass., is a creditable substantiation of this statement. As is well-known, this company manufactures sockets, switches, cut-outs, and all kinds of incandescent light details. It is in the third year of its existence, is doing a large and profitable business in its particular line, and earning for itself a deservedly enviable reputation through the merits of its manufacturers and the energy and able management of its president and manager, Mr. Norman Marshall, to whom are due many of the special machines and labor saving devices employed in the conduct of its business.

In our present issue we illustrate two portions of the extensive and well-equipped factory of this establishment, which is located in the upper portion of the large 4-story building at 336 Congress street, Boston, situated near the water front and in every way well adapted for the purpose to which it is devoted. The cuts presented are almost self-explanatory, and show respectively the assembling room (where the various parts of the different devices are put together) and the general machine room. The whole of the establishment, however, could not be included in these two illustrations, which embrace also commodious





store rooms, a huge vault for the preservation of valuable dies, etc.' tubing room, buffing room, blacksmith room, dipping room for switches, and an office equipped with all modern conveniences. In fact, the establishment throughout is a veritable beehive of industry. In the machine shop, aside from the work upon special tools and machinery necessary in the manufacture of new specialties, and improved processes, brass rods and plates seem to be disappearing in all directions, and small pieces of metal formed in curious shape are dropping merrily from machines into boxes to be transferred to other machines until finally ready for the assembling room, where with wonderful rapidity, by means of innumerable screws and pieces of brass, sockets, switches and cut-outs are completed—a socket for instance going through ten different hands, each doing its part. The company is at present employing about 60 people, occupies a floor space of about 16,000 square feet, and is arranging to double its capacity during the coming month in order to carry out contracts and orders on hand. Aside from sockets and switches, the company deals in Watchmans' Electric Time Registers, Mechanical Gongs and Metal Novelties generally.

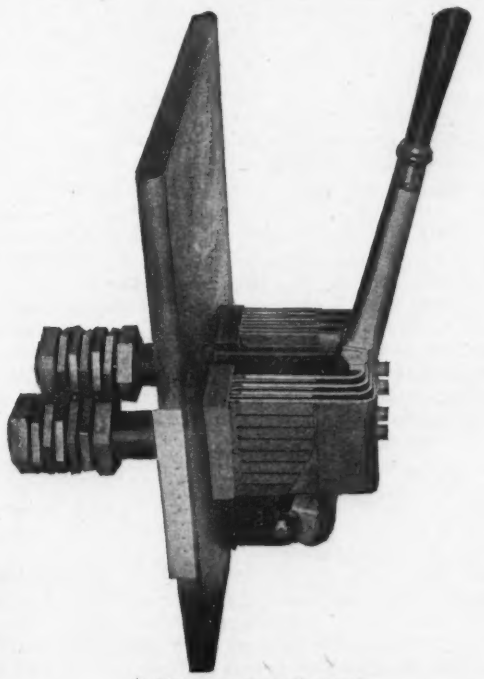
A Large Switch.

As late as April, of last year, a switch which was guaranteed to successfully rupture a circuit carrying 3,000 amperes of current at a potential of 500 volts, was considered a giant in breaking capacity, and it remained for the Ajax switch, described in the technical papers of that date, to demonstrate the utility of such large, quick break switches, and the ability to open a circuit carrying 2,000-h. p. of electrical energy at 500 volts potential, without the slightest injury to either the operator or the apparatus. During the interim, Ajax switches have been designed for 4,500 amperes (50 per cent. larger than any attempted before) and several such are in actual service on street railway circuits.

We now are enabled to illustrate another advance in switches, the one shown in the cut representing a new "plunger type" Ajax switch of 7,000 amperes capacity. This switch is guaranteed to break its full rated capacity at 500 volts potential, or nearly 4,700-h. p. It was ordered from C. S. Van Nuis, 136 Liberty Street, New York, by the Electrical Traction Company, of Philadelphia, through the General Electric Company, which is building the switchboard for the new Delaware avenue powerhouse.

Except the carrier and stand, which do not form any part of the circuit, the entire switch is made of commercially pure copper, and provision is made for clamping direct to a laminated bus bar, consisting of six bars, each 5"x¼", or a total of 7½" sectional area, which is also the minimum of sectional area in any part of the switch.

The contact area, finish and action are of the well known Ajax standard. The switch is compact in form and occupies a space only 14"x13" on the switchboard. A handle of unusual length is required to



7,000-Ampere Switch.

operate these large and close fitting blades, which overhangs the switch proper several inches; the total length of the handle from the pivot is 41½", and terminates in a highly polished piece of old mahogany. As a continuous current circuit breaker, it is believed the subject of this sketch is the largest yet attempted.

The Monocyclic Alternating System.

The General Electric Company is now placing on the market a new alternating system for simultaneous light and power work, which marks an important departure in this branch and one of much interest.

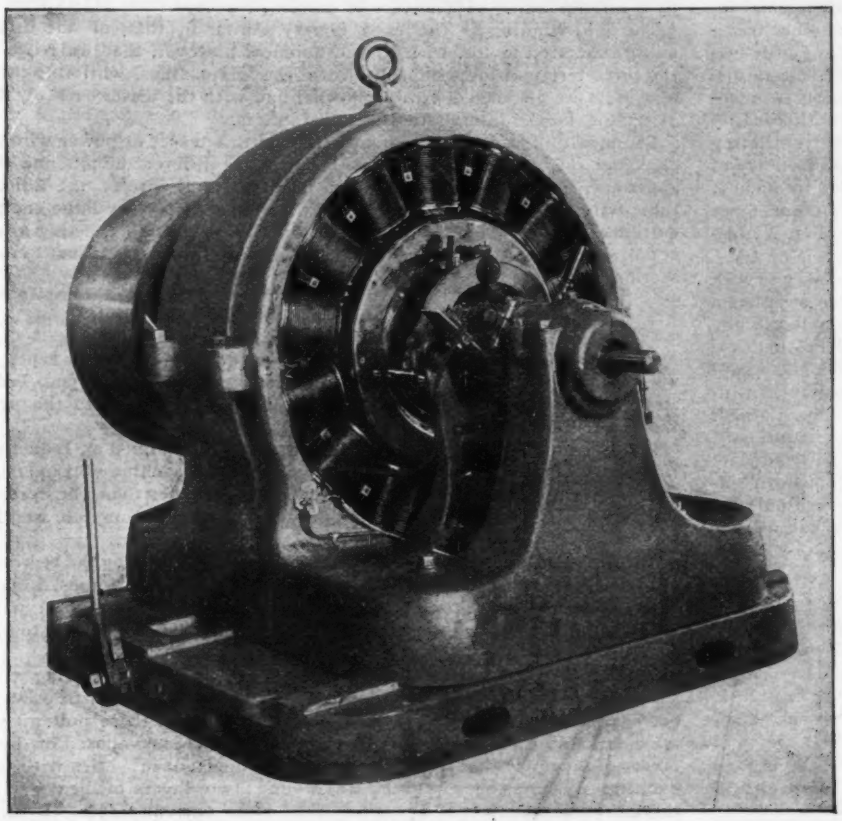


FIG. 1.—120-KW LOW FREQUENCY ALTERNATOR.

The working current is the simple alternating one; the transformers and lighting circuits are precisely the same as in the usual alternating system, and the motors are of the simple alternating (not multiphase) induction type, but with an auxiliary circuit, which constitutes the peculiarity of this system.

The monocyclic system has been devised, not for long distance power transmission, for which a three-phase arrangement of circuits is generally preferable, due to the saving of copper incident thereto, but for service of both electric lighting and power in which the importance of the former predominates. In short, the monocyclic system takes the place of the well-known high frequency system in central station work, operating transformer systems and distributing networks in the same manner, as indicated in Fig. 3.

It offers, however, over the old high frequency system the advantage of being able to supply not only light but power also, in this latter respect being equal and even superior to the continuous current system by the superior quality and reliability of the induction motor, its absence of brushes, commutators, etc., and by the flexibility of voltage incident to the use of the transformer.

While this new system can be operated in exactly the same way as the well-known high frequency system in common use nowadays, it offers in its application the essential advantage of higher efficiency and ability of supplying power. It has at the same time been specially designed for operating low tension net works on the Edison three-wire system in the same way as the continuous current lighting system, now in common use, and even with the use of the same overhead or underground mains, and offers in this case the advantage of a better balance and of a less eexpenditure in copper by replacing the heavy low tension feeders with high tension primary feeders of much less cross section, feeding into the mains by transformers. With this object in view, the generators are specially designed for parallel running, and parallel operation on a common system of bus bars is recommended in all larger stations, as shown in Fig. 3.

The frequency of the monocyclic system has been fixed at 7,200 alternations per minute or 60 cycles per second, this frequency being better adapted to the general requirements of incandescent lighting than any other, since higher frequencies occasion inductance effects in conductors, which more than outweigh the advantage gained in reduced transformer cost, while with lower frequencies, the increased cost of transformers is a serious objection. For arc lights also, this frequency is very desirable, since a lower one produces an unstable arc, and a higher frequency increases the humming incidental to alternating arcs. At 7,200, this humming noise is unappreciable. Besides, this frequency gives a convenient number of poles in motors at moderate speed, and is consequently well suited to power work, while at the same time it allows the operation of generators running at about one-half the speed of the old type high frequency alternators.

For very long distance work occasionally a frequency of 33 cycles per second or 4,000 alternations per minute is used. In this case 33 cycles have been chosen as being 10 per cent. higher than the lowest frequency at which incandescent lighting is still perfectly feasible. In general, however, 60 cycles per second or 7,200 alternations per minute are preferred as a standard frequency.

The reliability of the generators is increased by the care bestowed on the insulation, which renders the use of high voltages possible. The number of armature coils has been reduced, and these coils are machine wound, insulated, and afterwards slipped into the armature slots, thus making them easily replaceable. The generators are compounded for constant voltage under all loads, or over-compounded up to 15 per cent., to take care of the drop of voltage in the line. The bearings are both self-aligning and self-oiling, running exceptionally cool and with scarcely a tremor. Most of the machines can be arranged for direct coupling with high pressure water wheels, the larger units with turbines. All the generators have a commercial efficiency of from 90 per cent to 95 per cent. in the larger sizes. Fig. 1 illustrates a low frequency generator of 120-kw capacity.

All the low frequency alternators are fitted for use as synchronous motors; most of them will start from rest and run up to speed under light loads without the use of clutches or starting motors. They have as synchronous motors the same high efficiency as generators, and will stand heavy over-loads without falling out of synchronism. They also possess the valuable property of compensating for the

FIG. 2.—200-KW SUB-STATION TRANSFORMER.

drop of voltage by the self induction of the line, and for idle currents by their action as condensers.

The transformers employed in the monocyclic system are designed for frequencies between 33 and 60 cycles, and thus can be operated not only at the standard frequency of 60 cycles, but also in those cases where for long distance work 33 cycles have been chosen. All these transformers are oil-insulated. Sub-station transformers have also been designed for larger units, especially for power transmission work where the transformer units may be banked in groups of large output. They are specially suited for step up and step down work and for all sub-station distribution. They are without oil insulation, the coils being so insulated as to render this precaution unnecessary. They are thoroughly ventilated, and each bank is provided with one or more ventilating blowers, passing a draft of cool air through them. The efficiency of these transformers is very high, notwithstanding the decreased frequency, owing to the care used in selecting the iron, and ranges from 96.5 per cent. to 98 per cent., and even higher in very large units. Fig. 2 illustrates a 200-kw sub-station transformer.

As before said, the lighting system is operated in the same way as with the old alternators, by two wires and one transformer, which supplies a two-wire or an Edison three-wire system from its secondary terminals. From the same mains, however, motors are operated, and in this case two transformers are used, connected between the main wires and a supplementary or power wire; in which, by the action of the motors, an intermediate but laterally displaced voltage is established and maintained. For this purpose, the generator armature contains, besides the main coil, a small supplementary or teaser coil, which is connected with one end to the centre of the main coil, while the other end is lead to a third collector ring. It is obvious that this third collector ring is used only for supplying motors, while the lightning current passes exclusively

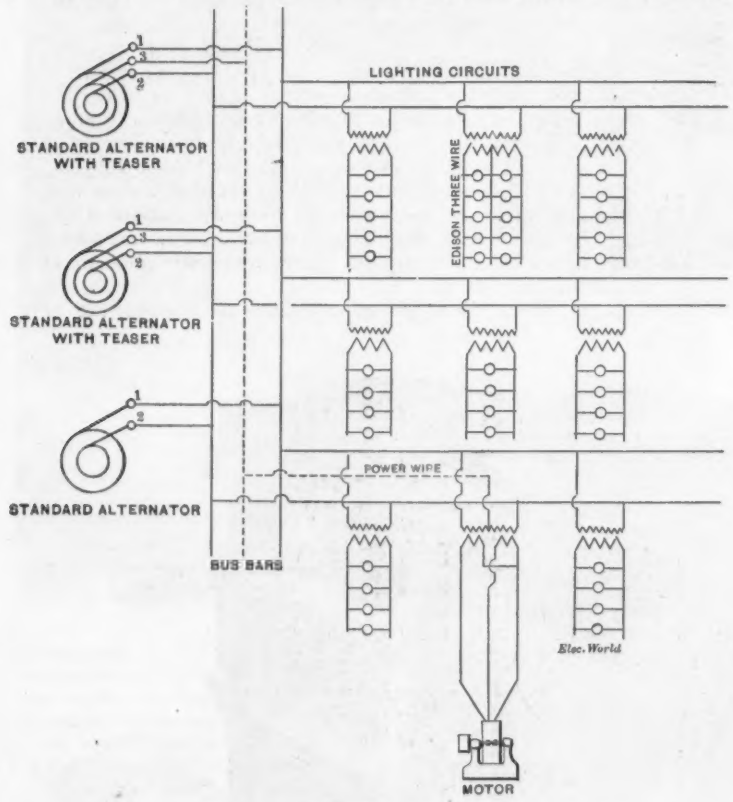


Fig. 3.—Diagram of Circuits.

through the main collector rings, and that the third or power wire needs to be carried only to where motors are located, and, since it does not convey large currents, needs to have a small cross section only. Fig. 3 shows the different connections possible to the circuit.

The most interesting feature of this monocyclic system is the monocyclic induction motor operated therefrom. As our readers are aware, an induction motor is one with a closed circuit armature having no connections with the supply circuit. Such a motor, however, can, with a simple alternating current of the old type of machine, not start of itself from the rest under full load without excessive current. This difficulty has been overcome in the new monocyclic motor, which in its action is essentially identical with the best three-phase motors built. It has a closed circuit armature wound with a small number of heavy copper bars of low resistance, and a starting rheostat is placed within the armature spider. At starting, a collar sliding along the shaft is kept out of contact with the switch used to short circuit the resistance, but when the motor is approaching full speed, the contact ring is moved along the armature shaft until the armature is short circuited on itself. Thus a very large starting effort is obtained, with the current limited to a reasonable amount by resistance.

In all the standard induction motors, the starting resistance is adjusted so as to give a starting torque 50 per cent. in excess to the running torque at full load, and requiring therefor an excess of 50 per cent. of current over full load current. By special adjustment of the starting resistance, the starting current can be limited in any desired manner, reducing, however, the starting effort proportionally, while a very large starting effort of 10 or more times the running torque, can be secured, by a corresponding expenditure of current, however.

The field winding of the motor is very similar to that of the three-phase induction motor, with the difference, however, that only two of the three terminals are connected with the main lines, while the third terminals are connected with each other and with the teaser coil of the generator, by the intervention of transformers.

The result of this arrangement is that in this teaser or power wire an exchange of current takes place between the different motors and the generator, in a similar manner as in the neutral wire of the Edison three-wire system. Thus the power wire does not carry large energy currents, but only the magnetizing currents of the motors, acting as an equalizing connection between them, and needs to have a small cross section only.

The New Wood Iron Clad Alternator.

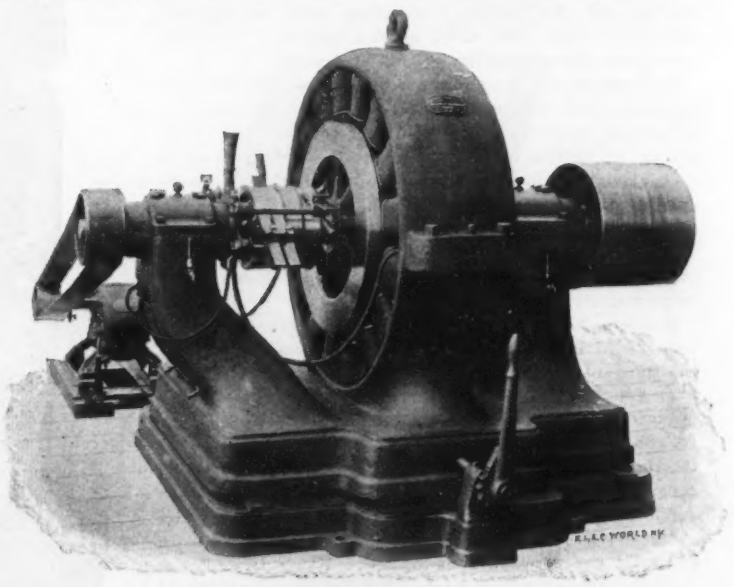
In our issues of June 23 and June 30 we described the new types of apparatus of the Fort Wayne Electric Corporation, Fort Wayne, Ind., and are enabled now to add some further details in regard to the new Wood iron clad alternator.

In the design of this machine, two points have been aimed at, reduction in amount of material and in speed at which the machine will operate. The new Wood alternator runs 350 revolutions slower than the former type, and has 1,000 pounds less copper wire on it, and complete weighs 650 pounds less.

The bed plate is cast in one piece. The pedestals carrying the bearings are massive, and well able to take care of the strain imposed upon them. The bearings proper, which are of bronze, are mounted in flexible iron sockets giving elasticity, and rendering the boxes free to expand in case of heating.

The field magnets are of cast iron, being in the form of a ring with inwardly projecting pole pieces, which are slotted in order to prevent eddy currents being generated in their faces. Over these pole pieces are compound coils of copper wire; each of these is composed of four layers of a comparatively small wire and connected in series with the exciting dynamo, over which are wound two layers of heavy wire through which the rectified portion of the main current passes. By this method of compensation or over-compounding any line loss is made good, automatically and instantaneously.

The armature of this alternator is a new departure, being made up of C-shaped stampings, which construction introduces an economy by enabling scrap stampings to be used, and provides an enormous radiating surface. The coils consist of a very few turns of copper ribbon, and are carefully enclosed in solid mica ducts $\frac{1}{16}$ inch in



Iron Clad Alternator.

thickness and set well below the surface, making it impossible for the coil to fly out under any circumstances, and obviating damage from bands or external fastenings becoming loose. The insulation of each coil is carefully tested with 5,000 volts alternating current between the coil and the core before the armature is placed in the fields for final test. The number of turns per coil has been made as small as possible, but at the same time the volts per inch have been increased as much as possible, and the armature induction carried to the highest practical point—to 8 kilogausses. As a result, one volt is produced for every 3.6 inches of armature conductor. In spite of this, however, the armature runs practically cold on a continuous run with a full load. This result is

undoubtedly due to the peculiar construction of the armature core, which is not built up of rings or segments as has been customary in all previous dynamos, but, as stated before, of C-shaped stampings which are put together like a link belt, only that the laminæ do not register with one another, but are stacked in sets; this leaves air spaces not only between themselves, but also air ducts around the active coils, formed by the failure of the punchings to register correctly, as above stated. This construction gives a large radiating surface, equal to about forty times the actual surface of the armature, and as the armature rotates powerful air currents are circulated through its sieve-like periphery, causing the core to run very cool. The one end of the armature coils is connected to one of the collecting rings, while the other end is connected to one side of the commutator, the other commutator segment and remaining collecting ring being connected together. When the brushes are properly placed on the commutator and rings, and the proper external connections are made, the main current, or a portion of it, is rectified and sent through the series coils of the field, in order to compensate for drop in the external circuit.

The initial excitation is produced by an exciter which accompanies the alternator, and which is also of the slow speed type with an iron clad armature, and gives practically constant potential on all changes of load. It also has a maximum capacity of double the current required to excite the alternator which it accompanies, thus giving a considerable working margin.

The construction of the brush yoke on this machine is also a new departure, the yoke being made somewhat less than a half circle, and placed below the centre of the shaft, and adjusted from an independent pedestal. The advantage of this arrangement is that it permits the removal of the armature without disconnecting the yokes, brush holders or connections. The field shunt, or non-inductive resistance, is hung inside the pedestal, where it is removed from all danger of destruction or alteration, and is ventilated by a forced draught from the armature, which is carried in ducts cast in the main frame of the machine. This pedestal has a perforated removable door, from which the shunt may be inspected from time to time. A sliding base also accompanies these alternators, which not only enables the attendant to move the dynamo, so as to properly adjust the belt, but at the same time move the exciter, so that the tension of the exciter belt is not altered in changes of position of the alternator. This is a very convenient improvement, as it enables this part of the work to be done quickly and by one man. On the commutator two sets of brushes are used, each side in multiple, so that one set can be removed for trimming while the machine is in operation. On the collecting rings of the large size alternator, two sets of brushes are used in tandem, so as to give increased carrying capacity, and also admit of the removal of one brush, if necessary from any cause.

A New Multipolar Dynamo.

We illustrate in the accompanying cut the multipolar dynamo and motor of the Electrical Mfg. Co., Dr. G. H. Zahn, Corry, Pa. As will be readily seen, great care has been given to produce an artistic design, a solidity of construction and a close adjustment of proportions within the machine.

The magnet frame is of the ring shape and cast in one piece, insuring a good magnetic circuit and great mechanical strength. The armature is of the Gramme ring type, and carefully annealed sheet iron rings of the best quality are used in building up the core. These rings after being

MULTIPOLAR DYNAMO.

insulated are clamped between two halves of a bronze spider, held together by steel bolts in the interior of the core. The commutator is of very massive design, made of tempered copper and insulated with mica exclusively. The shaft, of the best machinery steel, runs in self-oiling phospher bronze bearings.

The new line of standard machines brought out by this company are of high efficiency and guaranteed to be free from defects in workmanship and material and to run with perfect automatic regulation without any sparking and injurious heating.

New Arc Lamps.

The lamp which we illustrate, manufactured by Auerbach-Woolverton Electric Company, Broadway and Houston street, New York, is a wide departure from the usual form of arc lamps. The lamp complete measures but 18 inches from the top to the bottom, including the globe, and therefore is particularly adaptable to ornamental treatment. It is

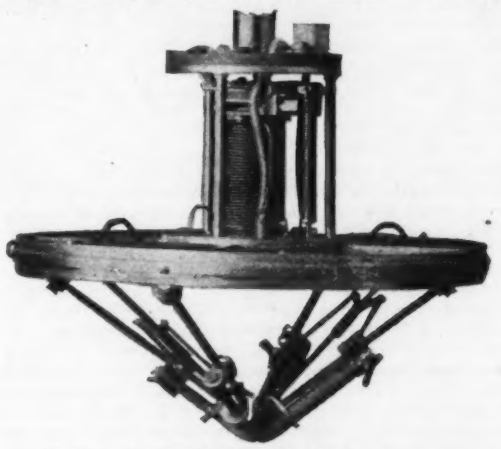


FIG. 1.—MECHANISM OF LAMP.

claimed that the carbons have a life of 25 hours in the open air. Owing to the disposition of the carbons, the arc is constant in position, all the light is thrown toward the ground, and there are no shadows whatever cast.

The only mechanism about the lamp, except the gravity feed, is that connected with the single magnet shown, and this is only used to strike the arc. The two positive and two negative carbons are respectively held in two inclined frames, one of which is rigid and the other one hinged in order to enable the arc to be struck. The carbons are fed by gravity, each carbon holder being guided by two rods in the inclined frame. To insure uniformity of feeding the carbon holders of each pair

FIG. 2.—LAMP COMPLETE.

are connected by levers pivoted to a central part, which slides along a guide rod as the carbons are fed; by this means each carbon of a pair is advanced at exactly the same rate. When out of circuit the carbons are in contact, but when the lamp is switched into circuit the central magnet shown strikes the arc. As the carbons are consumed they are fed down by gravity, the ends of the positives or the negatives respectively always being together, thus maintaining constant the distance between the positive pair and the negative pair. From this it will be seen that the magnet plays no part in feeding, its function in the high tension lamp illustrated being merely to strike the arc; in the low tension lamp, however, there is a regulating magnet.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 6, 1894.

THE ELECTRICAL STOCK MARKET during the financial week ending to-day has been rather irregular in its movement. Trading proclivities are still on the bear tack, and Wall street sentiment is accordingly still averse to any boom in stocks of any kind, but the favorable circumstances connected with one or two companies have made their stock and bond issues act independently of the general market, so that some quotations in the appended table are higher.

GENERAL ELECTRIC'S quotations, as a result of the week's trading, are practically unchanged. The stock seems to have settled down betweens 35 and 40, but at these figures prices are held with a tenacity that betoken a deal of restored confidence in the company's condition. Severe attacks have been made on the stock during the week and the most aggressive of the bear clique have put forth their powers in an attempt to locate its quotation, putting into circulation all sorts of stories about defective apparatus being returned by customers, treasury assets being sold, etc. They have not, however, met with any degree of appreciable success; all the adverse stories have met with prompt official denial, while, on the other hand, there is plenty of gossip of a favorable character to more than offset the bad feeling created by the spreading of the ill-natured reports above referred to. Here is the way one authority on General Electric is quoted as expressing himself: "General Electric is worth present prices, because it is doing a profitable business. The company earned all its fixed charges for the year in the first six months and is profiting greatly at present by the disablement of the Siemens-Halske Company as a consequence of the recent fire. The one great bar to anything like an important advance in the stock is the fact that dividends are neessarily a long way off, while on the other hand a good guarantee against any decline is the fact that the company is doing a large business on a sound basis and is earning considerably more than its fixed charges." The company is still retiring its 5 per cent. bonds with such funds as become available from time to time; it is estimated that between $600,000 and $700,000 have so far been brought back, so that they now figure as treasury assets. These purchases have been made without sales to any considerable extent of treasury assets, though there are securities in the treasury available, as, for instance, some 2,500 shares of New York Edison Illuminating Company stock and other equally as good assets. The directors are not, however, in a hurry to sell any of these.

WESTERN UNION TELEGRAPH stock is up a little, though bear raids have made it lose most of its gain. The attempt to bear the stock by selling it short has again proven futile. As has been repeatedly pointed out in these columns, the floating supply is so small as to make it impossible to cover a large short interest, and the minute that does assume decent proportions the risk becomes too great to admit of further bear operations. There is some talk of further fresh opposition to Western Union springing up, but it is not stated just how this is to be done. The indefiniteness of the threat, therefore, fully destroys its force. People generally well informed as to the affairs of Western Union know nothing of this rumored paper competition. On the other hand they tell that business keeps right on picking up, earnings for the quarter ended September 30 being understood to be nearly $100,000 better than the estimate.

WESTINGHOUSE ELECTRIC issues fail in developments. There is nothing new regarding the company's finanial affairs or prospects than was herein outlined last week. Quite a steady demand keeps up for the common stock, yet it is pronounced enough, from a stock market view, to make the stock conspicuous by reason of its activity. Quotations, however, hold excellently, the reports of business fully warranting the existing level of prices.

AMERICAN BELL TELEPHONE matters, as hinted at a week ago, promise important developments at an early date. It is understood, acccording to information from Boston, that the Board of Directors will, at the October meeting, next week, take up the question of the future policy of the company in relation to long distance extensions. These would have been farther advanced at this day had the Massachusetts legislation of last winter been less restrictive. Nothing further is heard of the Bell Company's supposed ally in this State, the Standard Telephone Company, whose final incorporation was recorded Friday, but it is now generally believed that something will come of the matter. Bell Telephone is now recognized as a 15 per cent. stock, so that its quotation, 202, ex-dividend, is rather low.

THE NEW YORK EASTERN TELEPHONE COMPANY, which recently got a franchise from the aldermen of Brooklyn, N. Y., is about to offer its bonds to the investing public. The company agrees to pay the city 1 per cent. of its gross receipts every six months; to furnish the city with telephone service at a price for each instrument not exceeding $40 per annum and to the general public at a price not to exceed $75 per year. Investors should bear in mind, however, that a question as to the validity of the franchise has been raised, and, until the matter has been settled by the courts, it will be well to let the bonds severely alone.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES is buying in as much more of its preferred stock issue as $50,000 will purchase. Proposals for sale will be opened by the trustees on Monday next.

THE ERIE TELEGRAPH AND TELEHPONE COMPANY announces that it has appointed as New York transfer agent the New York Guarantee and Indemnity Company, with the Seaboard National Bank as registrar. The old Colony Trust Company and the Globe National Bank will respectively act as the Boston transfer agent and registrar for the company.

THE INTERIOR CONDUIT AND INSULATION COMPANY'S quotations, despite the general good business transacted by this company for the past few months, are still inclined to drop, that is so far as outside trading is concerned. Brokers report the stock as offered at 35, which is 10 points below the quotations of a week ago. It is thought stock prices were forced above current market figures, so that a retrogression is natural. Officials of the company are, however, well satisfied with its status.

"Asterisks," as indicating ex-dividend, are becoming more numerous in the Electrical World's table of quotations. These "marks of honor" tell the story of what electrical stocks are doing. To the quotations so marked this week there should be added New York Edison Electric Illuminating and Brooklyn Edison Electric Illuminating, which have declared dividends, but whose books are not yet closed. Boston, Chicago and Philadelphia illuminating properties will also soon be quoted ex-dividend.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101⅛	102¼
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	38¼	38½
General Electric pref	100	70	72
Interior Conduit & Ins. Co.	100	25	35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	34½	35½
* " " pref	50	52	53

BONDS.

*Edison Electric Ill., New York	1,000	107⅛	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	200	202
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	100	51	52
Gold & Stock Telegraph	100	102	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	50	60
*Western Union Telegraph	100	89⅛	89¼

*Ex-div.

NEW INCORPORATIONS.

THE NORTHERN ELECTRIC COMPANY, Chicago, Ill, capital stock $25,000, has been incorporated by Joseph Kettlestrings, Geo. W. Furbeck and W. I. Marshall.

THE BELVIDERE TELEPHONE COMPANY, Belvidere, Ill., has been incorporated by W. M. Morean, Omer H. Wright, Jr., Jno. B. Tripp and J. B. Balliet. The capital stock is $5,000.

THE ARCTIC FAN COMPANY, Baltimore, Md., capital stock $50,000, has been incorporated by Geo. W. Smith, Jno. B. Maloney, Jno. W. Hartsell, Harry O. Hartsell and Harry Tilghman, to manufacture electrical and other novelties.

THE MISSOURI DISTRICT TELEGRAPH COMPANY, St. Louis, Mo., capital stock $250,000, has been incorporated by L. C. Baker, R. H. Bohle, C. J. Frankel, C. H. Bristol and J. W. Jones, all of St. Louis, for the purpose of constructing and operating magnetic telegraph lines.

THE CONSUMERS' ELECTRIC LIGHT COMPANY, Pana, Ill., capital stock $5,000, has been incorporated to furnish electric light, heat and power. O. H Paddock, D. J. Overholt, J. C. McQuigg, W. W. Morrison, J. L. Connor, Aug. Reher and John Kuhn are interested.

THE INDEPENDENT ILLUMINATING COMPANY, Chicago, Ill., capital stock $10,000, has been formed to generate and supply electricity, also to make and sell gas, etc., for heating and lighting purposes, power, etc. Christopher Treilbec, John McMillin and George Ham are interested.

THE TEXAS PACIFIC MANUFACTURING COMPANY, of Fort Worth, Tex., Tarrant County has organized for the purpose of maintaining and constructing a telegraph and telpehone line and to manufacture and supply light to the public. The capital stock is $20,000, and the directors are R. D. Hunter and H. C. Huntington, of Fort Worth; C. V. Sidell, 146 Broadway, New York City, and others.

THE PRAIRIE STATE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $500,000, has been formed to build railways, erect and maintain electric plants, to supply light, heat and power, and to operate telegraph and telephone lines. Hosea W. Wells, V. H. Surghnor and E. A. Maynard are the incorporators.

THE ELECTRIC MATCH AND ADVERTISING COMPANY, Cincinnati, O., capital stock $10,000, has been formed to sell, hire and lease mechanical electrical devices used for advertising purposes, and as cigar lighters, etc. Talton Embry, George Slimer, Joseph T. Homan, O. J. Wiggins and Wm. Montgomery are the promoters.

THE PACIFIC ELECTRICAL COMPANY, San Francisco, Cal., capital stock $30,000, has been formed to deal in and manufacture electrical and other goods and do a general manufacturing and construction business. W. S. Beckwith, Piedmont Springs; I. E. Richey, Oakland; E. H. Kimball, John T. Hogan and Geo. A. Clough, of San Francisco, Cal., are interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway' NEW YORK, Oct. 8, 1894.

CHEAP TELEPHONE SERVICE.—Mr. Dwight W. Curtis, a member of the Produce Exchange, is president of a company which proposes to supply a New York telephone service for $2 per month.

AT A MEETING of the Brooklyn Bridge Trustees, Mr. Keeney moved to adopt electricity as a means of illumination in place of the present system. The Mayor seconded the motion, and every member of the board present, Mr. Skinner excepted, voted in the affirmative.

THE STATE ELECTRIC LIGHT & POWER COMPANY, of Brooklyn, has filed with the Secretary of State a certificate of an increase of cash capital from $200,000 to $500,000. The principal office of the company is at 74 Broadway, Brooklyn, N. Y. Noah I. Cocheu is the president and Wm. Seward the treasurer.

MR. WM. S. BARSTOW, of the Brooklyn Edison Illuminating Company was married on Oct. 4, to Miss Francoise Du Clos at New Brunswick, N. J. A silver dinner service, consisting of 143 pieces, was presented by the Edison Illuminating employees in Brooklyn and the directors of the Illuminating Company presented the bridegroom with a loving cup. The young couple have the most cordial wishes of the electrical fraternity for a long life of happiness.

INVISIBLE WIRES.—At the meeting of the Board of Electric Control last week several specimens of wire were exhibited that had formed part of overhead lines strung in violation of law, and which had escaped detection by being almost invisible a short distance away. There were seven different kinds of wires used. One was a thin but shiny copper wire, another was the thin green silk covered article, and a third was a dark gray that was almost indiscernible ten feet away. These wires were found by the inspectors only after the greatest trouble. Several of them were traced from 55 and 57 Broadway to the Tower Building, and thence to 1 Broadway. The wires were dropped from the flue of 1 Broadway, where further tracing could not be had.

NEW ENGLAND NOTE.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, October 6, 1894.

THE CITY FATHERS are taking means to have the unused tracks of the West End Street Railway, removed from the streets of Boston. They say that dead wires and unused tracks must go.

BROCKTON, MASS.—Mayor Whipple and his Board of Aldermen are to provide a plan which shall place all telephone wires underground.

NEW HAVEN, CONN.—At the annual meeting of the New England Telephone Company's Mutual Benefit Association, W. A. Hurd, of Hartford, was elected president. E. A. Smith, of Meriden, vice-president. F. P. Lewis, of New Haven, secretary, and F. H. Emblei, of New Haven, treasurer.

A TERRIBLE ACCIDENT.—C. E. Day, a trimmer for the Boston Electric Light Company, was killed on Oct. 4, while replacing the carbons in a lamp at the corner of Channing and Congress streets, and A. J. Monroe, another employee of the company, was fatally injured while endeavoring to assist him from his perilous position. It was an awful spectacle, and was witnessed by hundreds of horrified spectators, who were unable to do anything for Day's relief, and who were compelled, much against their will, to stand in the street and watch him slowly roast to death..

CANADIAN NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Oct. 1, 1894.

OTTAWA, Oct. 4th.

TORONTO.—The receipts of the Street Railway Company for last month were the largest in the history of the Company, and amounted to $104,152.21, as against $92.745.87 for the corresponding month of last year.

BROCKVILLE, ONT.—A war between rival telephone companies is threatened in Dundas county. The new company in opposiition to the Bell Telephone Company are putting in instruments for $10 a year.

ST. THOMAS, ONT.—The St. Thomas Street Railway has been sold to the syndicate which controls the Toronto, London, Cleveland, Montreal, St. John and Winnipeg systems. The line will be extended and converted into an electric service.

OTTAWA, ONT.—The act passed last session respecting the inspection of electric lights, provided that so soon as the standards and apparatus had been acquired, the Government might issue a proclamation fixing the date upon which the act should go in force. The standards and apparatus have arrived and been installed in the Standard's branch of the Department of Inland Revenue. Consequently a proclamation was issued on Saturday, declaring that the act shall come into force in Canada on the 1st of April, 1895. Inspectors have not yet been appointed but it is understood that Mr. O. Higman, who has been retained by the Government as electrical expert, will shortly proceed with the instruction of the present inspectors of gas and measure in the intricacies of electric standards. It is claimed the inspection of electric lighting can be done after a litt lepractice by anybody accustomed to the work of gas inspection.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, September 26, 1894.

EARTH CHARGING BY HIGH PRESSURE ALTERNATE CURRENT MAINS.—In January last a grey mare was killed at Bournemouth by an electric shock. Owing to the mysterious manner in which this unfortunate animal met its death, the Town Council of Bournemouth thought it necessary to wire to the Board of Trade to send down one of their inspectors to investigate the whole matter. The inspector reported that the cause of the accident was that there was a defect in the insulation of one of the 2,000 volt mains, that this main came in contact with the enclosing wrought iron pipe, which was laid under the roadway at a depth of 18 inches and terminated at a *brick* junction box, and that in consequence the earth became charged on either side of the junction box to such an extent that between the fore and hind legs of the grey mare a sufficient difference of potential was established to give rise to the current which proved fatal to it. In a paper recently presented to the Royal Society on "The Difference of Potential that may be Established at the Surface of the Ground Immediately Above and at Various Distances from a Buried Mass of Metal Charged from a High Pressure Electric Light Supply," and the Board of Trade inspector (Major Cardew) gives the result of three experiments carried out by him at Chatham with a view to further elucidating the matter; the case of a death following from a simple contact with ordinary road material being a new experience of the possible dangers attending a commercial supply of electrical energy. Major Cardew concludes from his experiments that under very different conditions of weather and amount of moisture in the soil, it is possible to produce a difference of potential amounting to 25 per cent. of the total pressure, between points on the surface of the ground 4 ft. apart. Alternate currents alone were used in these experiments, but it is proposed at an early date to repeat these experiments with continuous currents. The following curious note is made by the author in the course of his paper: "The soil in which the pipe was buried was loamy, and when digging the trench no worms were noticed, but towards the conclusion of the experiments it was observed that hundreds of worms came to the surface, between three feet and nine feet on either side of the buried pipe; no worms appeared, however, immediately over the surface of the pipe." In another part of his paper, the author, speaking of another experiment, remarks: "The disturbance of the worms was again very distinct, and they appeared, on reaching the surface, to set their bodies parallel to the pipe or along the equipotential lines." It would appear from this remark as if the author contemplated mapping out lines of current-flow by means of worms, which it is to be hoped will prove amenable to electricity, as are iron filings to magnetism.

News of the Week.

TELEGRAPH AND TELEPHONE.

ASHEVILLE, N. C.—A company has been formed to construct a telephone system from Asheville to Weaverville.

CHARLESTOWN, W. VA.—William Campbell is in the market for a telephone equipment to connect half a dozen points a quarter of a mile apart.

ST. JOSEPH, MO.—A conduit franchise asked for by the Missouri & Kansas Telephone Company has been referred to a committee of the Council, but has not yet come up for a final issue.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY gave a reception at Terre Haute, Ind., upon the opening of its long distance lines connecting that city with the principal cities of the East and West. Mr. W. A. Vail, of the New York office, H. J. Curl of the Pittsburg office, Mr. Geo. C. Brooks, of the Chicago office, and Mr. John H. Cross, of the Cincinnati office, were among those present.

OYSTER BAY, L.I., N.Y.—Articles of incorporation have beeen filed with the Secretary of State at Albany, for a company styled the Long Island Co-operative Telephone Co., with a capital stock of $20,000. The plans were originated by Dr. Mann, of Jericho, Dr. Geo. W. Faller, of Oyster Bay, and Wilbur Johnson, of East Norwich, and its purpose is to extend facilities for communication by telephone throughout Long Island. Another meeting will be held at the Town Hall at Oyster Bay.

ELECTRIC LIGHT AND POWER.

GERVAIS, ORE.—The village is figuring on the expense of an electric light plant.

ELBERTON, GA.—Address the Mayor regarding the erection of an electric light plant.

LISBON, IOWA.—The Council will receive bids for putting in an electric light plant.

HUDSON, MASS.—Address Francis Brigham with estimates of the cost of an isolated electric light plant.

AMERICUS, GA.—This city is considering the erection of an electric light plant. The Mayor may be addressed.

ANNISTON, ALA.—The Anniston, Gas and Electric Company is reported to have asked for an extension of time.

ALBERT LEA, MINN.—The Committee on Electric Lights was authorized to advertise for bids for electric lighting.

SEYMOUR, IND.—The Council will receive bids for lighting the streets by gas or electricity. J. E. McKinney is city clerk.

NEW ORLEANS, LA.—The Louisiana Electric Light Company is considering the erection of a power station for electric car service.

PALATKA, FLA.—The electric light company represented by E. E. Haskell, has been granted a franchise to erect a plant in Palatka.

GRAND RAPIDS, MICH.—A resolution is before the Council to vote on an issue of $150,000 in bonds to purchase an electric light plant.

WAPAKONETA, OHIO.—An election will be held Nov. 6, to vote on the question of issuing $5,000 electric light bonds. Joseph Myers is clerk.

SHIPPENSBURG, PA.—The contract for lighting has been awarded to the Shippensburg Electric Light Company. Its bid was $1,500 per annum.

ASHLAND, KY.—A movement is on foot for the organization of a company to establish an electric light plant. A capital stock of $8,000 is proposed.

MERIDEN, MISS.—The Meriden Gas Light Company has awarded a contract to C. M. Rubush for the erection of its new electric plant, to replace the one recently burned.

CHARLOTTE, N. C.—The Charlotte Consolidated Construction Company will put in a complete incandescent system for lighting the city of Charlotte, in its plant at Dilworth.

STERLING, ILL.—Sealed proposals will be received until October 15 for lighting the city for a period of ten years by electricity. Bids to be received by the City Council.

CARROLLTON, GA.—Cliff Turner intends to remove his electric plant from Carrollton, and it is expected that a company will be formed to purchase same so that it will remain in the city.

PITTSBURG, PA.—The North Sub-District School, of the Fourth Ward, is to have an electric light plant, the power for which is furnished by an engine built by the Ball Engine Company Erie, Pa.

ST. JOSEPH, MO.—The Sommer-Richardson factory of the American Biscuit Co., is putting in a 500-light plant; the C. & C. apparatus is being installed and the construction work done by the Columbian Electrical Co.

KEENE, N. H.—The Keene Gas Light Company is to build an electric lighting station at Sprague ville. It will have five dynamos, and a powerful steam engine to use, if necessary, to supplement the two turbine water wheels.

NEW YORK CITY, N. Y.—At a meeting of Park Commissioners, the question of lighting Central Park by electricity was brought up. President Clausen said that the matter required so much discussion that he did not wish to make up, a hasty estimate.

PENSACOLA, FLA.—L. C. Sarra has been awarded a contract for the erection of an electric light plant by the new Citizens' Electric Light & Power Company. The machinery will include a 1,500-light incandescent dynamo and a 100-light arc dynamo.

POTTSDAM, N. Y.—At a meeting of the Electric Light Company a committee was appointed to secure a site for and erect a building, if it should be deemed advisable, at a cost not to exceed $15,000. The company proposes to erect a handsome fire-proof building.

PEORIA, ILL.—At the last meeting of the Board of Supervisors, J. D. McClure, J. V. Schmidt and George C. Murray, with Thos. Clinch, chairman, were made a committee to look after the matter of establishing an electric light light for county purposes, together with providing motive power for the court house elevator.

FALLS CITY, NEB.—At a meeting of the City Council of Falls City it was decided to close down the electric light plant, which belongs to the City, indefinitely. This action was caused by a report of a special committee appointed to examine the condition of the plant. The report says that the engines are in bad condition and not capable of running the lights.

OAKLAND, CAL.—The death of Mr. Van Leer Eastland, superintendent and general manager of the Oakland Gas, Light and Heat Company, removes one of the pioneers of the Pacific Coast in the branch of business with which he was so long identified. Mr. Eastland entered the employ of the San Francisco Gas Light Company in 1854, and was connected with the Oakland Company 27 years.

KINGSTON, N. Y.—The lamp committee of the Common Council, consisting of Aldermen Hamburger, Breitenbucher and Lundy, met at the city hall, and examined the plans for the electric light plant, which were submitted to them by Geo. F. Woolson, of New York, a representative of the Chicago Standard Arc Light Mfg. Co. The plant specified in the plans would cost about $45,000. They will meet again to discuss the matter.

DAVENPORT, IOWA.—A resolution introduced by Alderman Parkhurst was adopted providing that the Committee on Light and Finance and the Commissioner of the Board of Public Works be authorized to gather data relative to the cost of maintaining electric light plants in cities of the size of Davenport. The object of the investigation is to determine whether it is cheaper for the city to rect a plant or to depend on private enterprise.

HEMPSTEAD, N. Y.—The Board of Trustees of the village of Hempstead have called a special election to determine the question of lighting the streets with arc lights. There will be three different propositions to vote upon, from the Hempstead Gas Light Company, for 70 lights, at $84 per light per year; F.W. Werner, 70 lights, at $80 per light, and G. W. Graham, 70 lights, at $85 per light. All bids are for 800-candle power, the contract to run for five years.

DETROIT, MICH.—The trustees of Highland Park have granted to a syndicate, represented by Howie Muir, a thirty-year franchise for a street railway along Tuxedo avenue from Woodland avenue to Hamilton avenue, north to the six-mile road. Mr. Muir says that a modern street electric railway will be constructed. It is claimed that the object of the new company is to build up land owned by the syndicate and at the same time give the public facilities for visiting Palmer Park.

SPRINGFIELD, ILL.—The City Council voted unanimously to accept the proposition of the newly organized Citizen's Light Company for the construction of a municipal electric light plant for the city. The company is to construct immediately a plant to furnish more than twice as many arc lights as are now in use and is to receive the appropriations made now for street lighting purposes for five years. Then the plant is to be turned over to the city and is to be operated by it. Jos. C. Klaholt and E. D. Keys are the directors.

THE ELECTRIC RAILWAY.

MACON, GA.—The City & Suburban Railway Company may extend its line to the suburbs.

INDIANAPOLIS, IND.—An ordinance providing for the extension of the City Railway Company's lines was adopted.

HILLSBORO, TEXAS.—J. W. Maxwell and others are interested in a proposed electric line from the city to Rose Hill suburb.

NEW ORLEANS, LA.—The Carrollton Railway Company's Canal street division is to be rebuilt for electrical motors. Jos. Lennes is president.

HOUSTON, TEXAS.—The Houston & Suburban Railway Company has awarded no contracts as yet for building its road. E. W. Cave is interested.

DEPOSIT, N Y.—An electric railroad is projected between Deposit and Trout Creek. It is said that the New York Condensed Milk Co., is backing the scheme.

NEWTON, MASS.—The Newton Street Railway Company's directors have decided to make another extension of their line in Waltham. The line will be built this fall.

NEWARK, N. J.—The freeholders of Essex and Hudson have granted permission for an electric system to be used on the Clay street and Harrison avenue bridges.

CAMDEN, N. J.—The Camden Horse Railway Company has recently placed an order for two 350-hp Vertical Compound engines with the Ball Engine Company, Erie, Pa.

SOUTH WINDSOR, CONN.—At a hearing of the selectmen the petition of the president and directors of the Hartford Street Railway Co., to lay tracks for electric cars in that town was granted.

MIDDLETOWN, CONN.—Israel A. Kelsey, of this city, and A. C. Pond, of Boston, have bought the Middletown street railway, and will at once equip the property with the trolley system. The company will issue bonds.

LOWELL, MASS.—The Lowell & Suburban Railway Company will next year extend its lines to Mountain Rock Grove, where the company proposes to lay a half mile bicycle track and build a grand stand to accommodate 500 people.

SAN BERNARD, COL.—The Bear Valley Reservoir Company, A. P. McGinnis, receiver, will erect a new dam and reservoir. The company proposes to operate a car line and works with electricity developed by water power.

MANITOU, COL.—Arrangements are being made to build an electric road over Ruxton avenue to Iron Springs. The plant will be operated by water power. The capital is $45,000. M. A. Leddy is president and John Hurlburt secretary.

WASHINGTON, D. C.—The Metropolitan Railway Company will probably use an underground electric system on its Ninth street division. Seven miles of track and conduit will be required and motors specially built. A. N. Connett is engineer, and Samuel Phillips, president.

BALTIMORE, MD.—The electric railway which will run between Baltimore and Washington will soon be built, it is said. Surveyors have completed their survey of the line between Riverdale and Washington. The road will approach Washington via Hyattsville. David M. Newbold is interested.

CHICAGO, ILL.—The General Street Railway Company, in which Harry McCann is largely interested, has taken out a building permit to erect a car-house at a cost of $20,000, an engine-house to cost $35,000, and a repair shop to cost $11,000, at the corner of Thirty-first street and Kedzie avenue.

CHILLICOTHE, O.—Judge Douglas has confirmed the sale of the street railroad here. The road was purchased by Judge Warren P. Noble, Jos. Meyers and Alexander Kiskadden, administrator of Perry M. Adams, of Tiffin, O. They intend to rebuild the road, change it into a first-class electric street railway lighting and power plant, and put it on a good business foundation.

BATTLE CREEK, MICH:—The street railway company has passed into new hands and will be rebuilt at once. Mr. E. E. Downs, for several years with he General Electric Company, but for the past two years manager of the Kalamazoo Street Railway Company, has resigned his position in Kalamazoo and will commence work there at once to get the road in operation by January 1.

ORANGE, N. J.—At a meeting of the citizens of Springfield it was unanimously voted to favor a franchise to the North New Jersey Traction Company to build and operate an electric line from the terminus of the Consolidated Traction Company's Irvington line, through South Orange, to Morrison Road. The Consolidated Traction Company is said practically to control the North New Jersey Traction Company; in fact, its counsel, Halsey M. Barrett, admitted that its officers were about the same as the Consolidated Company.

BENNINGTON, VT.—A citizens' meeting was held at Bennington to see about the advisability of obtaining a special charter from the Legislature to build an electric railroad from Bennington to the New York State line, connecting with the Hoosick railway, and a committee, consisting of E. E. Larrabee, A. P. Childs, Major A. B. Valentine, N. M. Puffor and E. L. Sibley, was appointed to look over the proposed route and report at an adjourned meeting. Major Valentine reported in behalf of the committee. Jos. A. Powers, of Lansingburgh, is one of the owners of the Burlington electric railway.

MISCELLANEOUS NOTES

IT WAS OF DR. OLIVER WENDELL HOLMES, who died on Sunday, that James Russell Lowell wrote:

> "There's Holmes, who is matchless among you for wit,
> A Leyden jar, always full charged, from which flit
> The electrical tingles of hit after hit."

THE ELECTRICAL CLUB OF CLEVELAND, O., on October 3, elected the following officers: President, Chas. W. Mason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. J. Davies; treasurer, E. W. Moore; Board of Managers, Chas. W. Mason, H. J. Davies, R. M. Fuller, E. W. Moore, Geo. W. Cleveland,

MR. A. N. MANSFIELD, S. B. of the Massachusetts Institute of Technology, now in the engineer's department of the American Telephone and Telegraph Co., will be the instructor of the Electricity Class at the Young Men's Institute of the Young Men's Christian Association, 222 Bowery, New York. Mr. Mansfield will endeavor to make the course of lectures meet the needs of young men engaged in various branches of electrical work. The class begins Oct. 2d and continues until May, 1895.

Trade and Industrial Notes.

W. D. HOFFMAN, agent of the Buckeye Engine Company, has removed to Room 92, Hathaway Building, 620 Atlantic Avenue, Boston.

THE QUAST GAS AND GASOLINE ENGINE COMPANY, Bucyrus, O., is in the market for good batteries and would be pleased to receive catalogues from manufacturers.

J. W. PARKER & CO., Philadelphia representatives of the Ball Engine Company, Erie, Pa., are installing one of their engines in the George W. Childs School Building, Philadelphia.

J. JONES & SON, 67 Cortland street, New York, are much pleased with the business outlook. They report a larger number of orders during September than during any month since they have been in business.

F. S. TERRY, 320 Dearborn street, Chicago, Ill., has been named assignee of the firm of Taylor, Dee & Mack, and gives notice that all persons having claims against the said firm must present such claims, under oath or affirmation, within three months from October 1.

MR. H. K. GILMAN was obliged to resign his position of business manager of the Great Western Manufacturing Company, Chicago, on September 1, owing to ill health. He intends to take a trip abroad for several months, and upon his return will resume his former duties if his health will then permit.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, has just arranged

to take the product of a well-known glass factory for insulators, and they will therefore be able to furnish the market with standard grades of insulators at factory prices. A large stock will always be kept on hand and immediate shipments can be made.

ROBT. W. SHOPPEL, 108 Fulton street, New York, is sanguine of the prospects of the Kings, Queens and Suffolk County bicycle road. Long Island was selected as the best field for the first bicycle road, and one that will immediately return the largest earnings, and he says that it is no exaggeration to expect that dividends paid by the K., Q. S. & Co. will be, at least, double the 8 per cent. guaranteeed.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has arranged to represent the Heisler series lamp exclusively in the West and carry a large and complete stock in Chicago. The Heisler series incandescent lamp is too old and well known an article to require any comments at our hands, and the Electric Appliance Company have undoubtedly added another good specialty to their celebrated line.

THE JEFFREY MANUFACTURING COMPANY, Columbus, O., is sending to its friends and patrons a handsome photogravure hanger, showing the different styles of coal mining machines built by it and arranged in the order of development, the improved chain coal cutter being the latest. The design is artistic and the different views illustrate in themselves almost the entire art of coal mining by machinery.

THE NORWICH INSULATED WIRE COMPANY, New York, has closed a contract with the West End Street Railway Company, Boston, to equip its road with underground wire, a recent order of the City Council requiring the West End Co., to bury its wires. Over 300 miles of Norwich "paper insulation" cables will be buried, 30 miles of which will be laid by the end of the year. The Norwich Insulated Wire Company has also closed a similar contract of large proportions with the Chicago Street Railway Company.

THE AMERICAN FUEL ECONOMIZER AND ENGINEERING COMPANY, 136 Liberty street, New York, in a handsomely printed and bound 38-page catalogue, gives an account of its apparatus for heating, and purifying feed water for steam boilers by utilizing the heat in flue gases. The illustrations are excellent and enable the principles of the Economizer to be easily understood. The final pages of the book contains useful data for steam users and engineers, including a table showing percentage of saving by heating feed water, properties of saturated steam, etc.

THE SIEMENS & HALSKE COMPANY of America, Monadnock Block, Chicago, has issued two large page catalogues, one descriptive of internal pole, and the other bipolar, dynamos and motors. Each pamphlet opens with a description of the type to which it is devoted, which is followed by a summary of the advantages. A lengthy list of plants installed also is given with many illustrations of machines. The various line and half tone cuts enable a very thorough idea to be obtained of the excellent machinery designed by this company whose career in America promises to rival that of the great parent company in Europe.

NORBERT B. KATES, 58 W. Eighth street, Cincinnati, O., intends shortly to establish in New York a general export agency under the name of the American Manufacturers' Export Association. Mr. Kates has just returned from an extensive trip through South America, and reports a promising opening for American goods if they are pushed with a full knowledge of the principles and customs of the trade. Among the companies which Mr. Kates has successfully represented are the Lodge & Davis Machine Tool Company, the J. A. Fay & Egan Company, the Lane & Bodley Company, the Harkness & Cowing Company, of Cincinnati, the Niles Tool Company, the Long-Alstatter Com. of Hamilton, O., the Buckeye Iron & Brass Works, of Dayton, the H. Wm. Dopp & Son, of Buffalo, N. Y., the S. A. Woods Company, of Boston, and others.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports the following recent sales in its Isolated Lighting Department: North Packing & Provision Co., Somerville, Mass., 1,000-lt. dynamo (3rd order); Hermann Aukam & Co., Lebanon, Pa., 600-lt. dynamo; Church Green Electric Light & Power Co., Boston, 600-lt. dynamo (9th order); Iowa School for the Deaf, Council Bluffs, Iowa, 600-lt. dynamo; Connecticut River Paper Co., Holyoke, Mass., 700-lt. dynamo, 2 15-hp Manchester motors; Henry R. Worthington, Hydraulic Works, Brooklyn, one 600-lt. dynamo, one 10-hp motor, and one 45-hp, 220-volt generator; J. B. Williams Co., Glastonbury, Conn., 150-lt. dynamo; Graif Bros., Lake Crystal, Minn., 150-lt. dynamo; Ohio State University, Columbus, Ohio, 15-hp Manchester motor; Grenada Hotel, Chicago, Ill., 450-lt. dynamo; Barney & Smith Mfg. Co., Dayton, Ohio, 3-hp Manchester motor; B. T. Sturtevant Co., Chicago, Ill., 10-hp Manchester motor; G. M. Angier and Co., Boston, Mass., 100-lt. dynamo; Candee Company, New Haven, Conn., 50-lt dynamo; Morehouse Bros. Chanterico, 50-lt. dynamo; Odd Fellows Hall, Philadelphia, Pa., 50-kw direct connected, 50-kw direct connected, 80-kw direct connected, and 50-hp. in motors: S. N. Blake, Elmira, N. Y., 350-lt. dynamo; Nardi Strang Co., Philadelphia, Pa., 50-lt. dynamo; George W. Furbeck, Chicago, Ill., 250-lt. dynamo; C. B. Boothe, Los Angeles, Cal., two 5-hp Manchester motors and one 3-hp Manchester motor; Badger Lumber Co. Kansas City, Mo., 100-lt. dynamo; Leafe Bros., Winchester, Va., 50-lt. dynamo; Stanley Laboratory Co., Pittsfield, Mass., 10-kw. exciter; Diamond Machine Company, Providence, R. I., 300-lt. dynamo; West Virginia, Improvement Co., Pocahontas, W. Va., 60-kw 220-volt generator.

Business Notices.

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs doing business at Rochester, N. Y. has been mutually dissolved.

All further orders for the Universal Switch Hook or Bradley-Combs switch Hook must be addressed to me as I am the sole inventor and owner thereof. Edgar S. Combs, 41 Stone street, Rochester N. Y.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

THE SOUTHERN RAILWAY, Piedmont Air Line, announces that arrangements have been perfected for movement of members and friends of the American Street Railway Association from the East and New England States upon one of the most elegantly equipped Pullman vestibuled trains, composed of dining and sleeping cars, leaving New York Monday, October 15, 1894. The route is via the Pennsylvania Railroad and Southern Railway ("Piedmont Air Line". Leave New York, Pennsylvania Railroad, 4.30 p.m.; leave Philadelphia, Pennsylvania Railroad, 6.55 p. m.; leave Baltimore, Pennsylvania Railroad, 9.20 p. m.; leave Washington, Southern Railway, 10.43 p. m. Arrive Danville, Southern Railway, 5.30 a. m.; arrive Charlotte, Southern Railway, 9.25 a. m.; arrive Atlanta, Southern Railway, 3.55 p. m. Time, 23½ hours.

THE SOUTHERN RAILWAY owns and operates the entire line ("Piedmont Air Line") Washington, D. C., to Atlanta; also the route through "The Land of the Sky" from Washington, D. C., via Lynchburg, Va., Danville, Va., Salisbury, N. C., Asheville, N. C., Knoxville and Chattanooga, Tenn., to Atlanta, and are prepared to handle passengers with absolute comfort and despatch by either route. The route of travel is through the fertile territory known as the Piedmont regions, and presents one of the most beautiful combinations of varied and attractive scenery.

For the occasion of the meeting of the American Street Railway Association, the following rate has been made: One full fare going, and, upon presentation of certificate, one-third fare returning. If you are going to Atlanta to attend the Street Railway Convention, remember the Southern Railway, in connection with the Pennsylvania Railroad, operates a solid Pullman vestibule limited, leaving New York daily at 4.30 p. m., arriving in Atlanta next day at 3.55 p. m., with dining car service. Returning, leaves Atlanta at 1.00 p. m., arrives New York following afternoon at 1.23. The only train having a through Pullman service between New York and Atlanta. Those who desire to take the trip should arrange in advance for sleeping car accommodations (no coaches) by advising early as possible; already a large number have secured space. Five sleepers are already booked from New York, which, on arrival in Washington via Pennsylvania Railroad, will be attached to the through train on the Southern Railway for Atlanta. Representatives of Lewis & Fowler, H. W. Johns, the Okonite Company, the Walker Manufacturing Company, and E. P. Hatch, of the Boston Street Railway Company; J. H. Cunningham, president of the Massachusetts Street Railway Association; the Boston Electric Club, and other prominent people have already secured transportation or engaged passage. The special train will be under the personal supervision of Mr. A. S. Thweatt, Eastern Passenger Agent of the road in New York. This line is 14 hours quicker than that via N. &W. R. R.

Call on or address: R. D. Carpenter, General Agent; Alex. S. Thweatt, Eastern Passenger Agent, 271 Broadway, New York. Waldo A. Pearce, New England Agent; Geo. C. Daniels, Traveling Passenger Agent, 228 Washington street, Boston, Mass. F. B. Price, Agent, 32 South Third street, Philadelphia, Pa. L. S. Brown, General Agent, Passenger Department, Washington.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 2, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

Reissue 11,442. SECONDARY ELECTRIC BATTERY; C. Theryc and Oblasser, Paris, France. Application filed July 4, 1893. This consists of a conductor, active material surrounding the same, and a perforated envelope of cellulose free from foreign substances, and having its parts united by cement having a celluloid as a base, the active material and conductor being inclosed on all sides by the envelope.

526,686. ELECTRIC MOTOR; J. H. Clark, Boston, Mass. Application filed April 16, 1894. A motor having a casting for the frame formed with a back having a hub on each side of the back and L shaped projections forming the poles of the field magnet. (See illustration.)

526,704. TROLLEY WIRE HANGER; J. J. Green, Boonton, N. J. Application filed June 4, 1894. This comprises supporting devices consisting of parts struck from sheet metal and formed so as to be adapted to conjointly engage the trolley wire supports.

526,705. TROLLEY SPRING; J. L. Hanson, U. S. Army. Application filed May 14, 1892. A spring comprised of two clasp springs having their spiral bends interlocked, and the ends of their members oppositely connected.

526,720. ELECTRIC WINDING AND SETTING CLOCK; H. Loriot, New York, N. Y. Application filed Oct. 3, 1893. This comprises a magnet, a synchronizing wheel, a pivoted armature lever, pivoted levers and means for restoring the several levers to their initial positions.

526,721. COMPOSITION OF MATTER FOR ELECTRIC CONDUCTORS; D McFarland, Philadelphia, Pa. Application filed May 16, 1894. A compound composed of asbestos or mineral wool, graphite and a binder.

526,722. COMPOSITION OF MATTER FOR ELECTRIC CONDUCTORS. D. McFarland, Philadelphia, Pa. Application filed May 19, 1894. A baked compound structure composed of graphite, clay, asphalt or coal tar, chloride of aluminum and a binder.

526,723. ELECTRIC IGNITING APPARATUS FOR FIRE ENGINES; W. C. Matthias and W. Hartman, Reading, Pa. Application filed Oct. 2, 1893. The combination with a gas burner and the electric igniting attachment thereto, a gas cock and stop, a vibrating arm and connected spring, an operating lever having a limited independent movement and a separate spring to hold the lever in operative position.

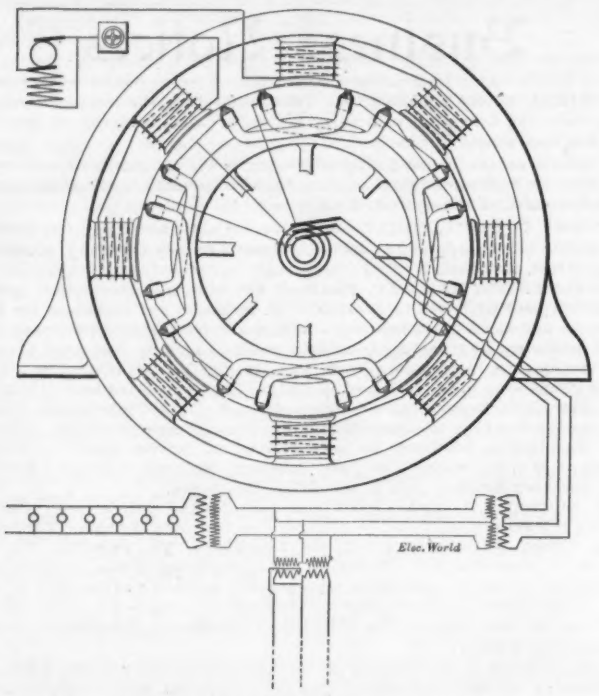
526,725. ELECTRIC SNAP SWITCH; A. Metzger, Schnectady, N. Y. Application filed May 11, 1894. This comprises a ratchet plug, ratchet faces at one end thereof, and a central longitudinal passageway for the handle shaft, with a recess at one end of the passageway and in the end of the plug surrounding the passageway.

526,736. LIGHTNING ARRESTER; F. S. Pearson, Boston, Mass. Application filed Sept. 7, 1891. This comprises a lightning arrester, a switch, its

detent, an electro-magnet, a fuse, a main circuit and a branch circuit with two branches, one branch containing the arrester, and the electro-magnet in series, and the other the fuse.

526,742. COMMUTATOR; H. G. Reist, Schnectady, N. Y. Application filed June 28, 1894. This comprises a supporting spider with the interior bevelled faces, a clamping ring and a bevelled nut adapted to fit the space between the clamping ring and the inner bevelled face of the spider, in combination with a commutator segment adapted to fit the opposite surface of the clamping ring.

526,743. DYNAMO ELECTRIC MACHINE; E. W. Rice, Jr. Application filed February 28, 1894. This comprises an armature having coils in series, connections to external circuits from the ends and an intermediate portion of the coil, and field magnetic poles embracing an arc less than the greatest angular displacement between the coils. (See illustration.)



No. 526,743.—Dynamo-Electric Machine.

526,756. TROLLEY GUARD; H. J. Tanner, Lynn, Mass. Application filed April 2, 1894. The combination with a trolley wheel and yoke, of balls or wheels which meet above the trolley wire and are separated by the pressure of the trolley wire upon them when the wire enters and when it leaves the space inclosed by the retaining devices and the wheel.

526,760. ELECTRIC ALARM OPERATING MECHANISM; P. C. Thompson, Elmira, N. Y. Application filed Dec. 19, 1893. The combination with a frame adapted to be placed in communication with an electric bell, of a track pivoted thereto, contact pieces on the frame and track, a ball weight movable on the track, mechanism independent of the track for driving a ball, and means for actuating the ball driving mechanism.

526,767. ELECTRIC RAILWAY CONDUIT; R. B. Wilson, Cincinnati, O. Application filed Jan. 2, 1894. The combination with a conduit, notched in the upper edge of its wall, of a bracket and a hanger-block.

526,810. APPARATUS FOR PUTTING ELECTRIC MOTORS INTO CIRCUIT; C. Hoffmann, Charlottenburg, Germany. Application filed Oct. 29, 1892. This consists in automatically and simultaneously varying the resistance of the circuit in inverse proportion to the counter electro-motive force of the motor.

526,825. ELECTRIC LAMP HANGER; W. S. Weston Chicago, Ill. Application, filed Jan. 13, 1894. The combination of a revolving lamp supporting drum and supporting cables, a frame upon which the drum is mounted, a circular ratchet attached to the frame, a revolving spring actuated pawl adapted to engage the ratchet, and means for operating and holding the pawl free from the ratchet.

526,833. ELECTRIC BELT; J. J. Hankey, Beaver Dam, Wis. Application filed July 18, 1894. This comprises a flexible waterproof casing, a pair of flexible batteries within the casing, an electrode detachably connected to the inner terminals of both batteries, and two electrodes, each of which is connected to an outer terminal of a battery.

526,835. CONDUIT RAILWAY TROLLEY; R. J. Hewett, St. Louis, Mo. Application filed Feb. 9, 1894. A conduit collector provided with an adjustable steering device engaging the slot walls at a point in advance of the plow to automatically adjust the collector to curves.

526,850. CONDUCTOR SWITCH; G. H. Benjamin, New York, N. Y. Application filed September 28, 1893. This comprises a main track and adjoining switch track, working conductors for each of said tracks, one of the tracks having a sectional conductor normally out of the plane of the conductor of the other track, but adapted to be brought into line with the adjacent sections of the conductor of its own track and close the gap there between.

526,865. TELEPHONE; H. W. Libbey, Boston, Mass Application filed Aug. 1, 1892. In a telephone, an armature arranged between the poles of a horse shoe magnet, and the diaphragm, the armature being suspended by cat gut or silk cord.

526,867. RHEOSTAT; D. McFarland, Philadelphia, Pa. Application filed May 18, 1894. This comprises a homogeneous baked composition structure for controlling or adjusting voltage of an electric circuit and provided with pin contacts, conductors from a source of energy in connection with said structure, and a switch adapted to be manipulated in the path of the contacts.

526,879. DYNAMO REGULATOR; J. Van Vleck, New York, N. Y. Application filed May 31, 1894. A series of dynamo regulators, each having a support of segmental shape, the supports having their curved peripheries side by side, a series of contact strips on each support peripnery, an arm provided to each support and carrying a contact plate over each series of contact strips, and a series of resistances connected with each series of contact strips.

526,888. TRANSMITTER FOR TELEPHONES; M. O. Anthony, Cincinnati, O. Application filed July 28, 1894. This comprises a supporting plate, a series of carbon blocks projecting therefrom, a series of carbon pencils extending from block to block, and a transverse pencil or pencils connecting one or more pairs of pencils in series and locking them against rotation.

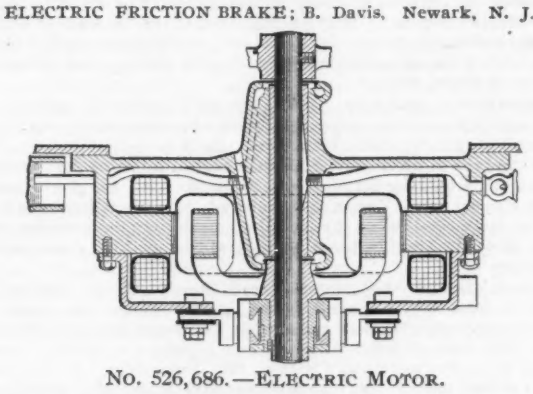
526,893. FIRE ALARM TELEGRAPH SYSTEM; W. E. Decrow, Boston, Mass. Application filed March 13, 1893. This comprises central and local stations, a circuit connecting them, a series of circuits extending from the local station, and a switch placed at a point outside the local station for disconnecting the lines therefrom, and connecting them in series with the central station.

526,897. ELECTRIC RAILWAY TROLLEY; R. A. Grant, Providence, R. I. Application filed January, 22, 1894. This comprises an end piece, pivot shaft, side frames, trolley wheel, spring, ratchet wheel, and pawl.

526,909. ELECTRIC LOCK, T. P. Pratt, Boston, Mass. Application filed May 7, 1894. This comprises a lock, a keeper for the bolt, and an electro-magnet and circuit therefor, the arrangement being such that when the circuit is broken the keeper is rigidly locked, and when the circuit is closed the keeper is released so that the bolt can pass out.

526,963. CONDUIT FOR ELECTRIC RAILWAYS; M. Cattori, Rome, Italy. Application filed April 3, 1894. This comprises a tubular conduit, a support located therein, and secured by its ends to the sides of the conduit, and a fish plate formed on to the chair to fasten the track rail in position on the conduit.

526,966. ELECTRIC FRICTION BRAKE; B. Davis, Newark, N. J. Application filed March 28, 1894. This comprises a drum mounted fast upon the axle, the same consisting of a metal hub and radial arms, and a peripheral portion formed of separate sections attached to the arms and insulated from each other, bobbins placed on the arms, a magnetizable strap surrounding the drum, and an electric circuit extending through the bobbins.



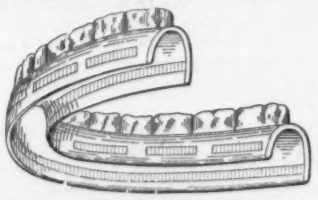
No. 526,686.—Electric Motor.

526,982. MAGNETO CALL BELL; J. B. Smith, Manchester, New Hampshire. Application filed April 27, 1894. This comprises a magneto machine having a rotary and longitudinally movable armature shaft, a crank shaft, gearing intermediate the armature shaft and crank shaft for imparting the longitudinal movement to the armature shaft during its rotation, the armature shaft being adapted when rotated to break the circuit and cut in the armature of the magneto generator, and a spring for returning the armature shaft to its normal position when at rest.

526,965. COMBINED TELEGRAPH KEY AND SOUNDER; P. D. Cox, Jasper, Fla. Application filed January 9, 1894. This comprises a base and key, a threaded stud, nuts on the stud and a spring resting on the nut and pressing the under surface of the key.

526,992. COMBINED SYSTEM OF ALTERNATING AND DIRECT CURRENT DISTRIBUTION; A. L. Clough, Manchester, N. H. Application filed May 15, 1894. This comprises distributing conductors, branches connecting translating devices to direct current mains, transformers having their primaries connected to alternate current mains, and devices to short circuit the direct current mains when the alternate current is on, and to remove the short circuit when the alternating current is off.

527,037. ELECTRIC MOUTH BATTERY; L. Funk, Chicago, Ill. Application filed November 27, 1893. This comprises metal plates of opposite polarity so disposed as to be exposed to excitation by the saliva in the mouth, and conductors not exposed to excitation by the saliva connecting the several plates. (See illustration.)



No. 527,037.—Electric Mouth Battery.

527,034. SCALE AND INDEX FOR ELECTRICAL MEASURING INSTRUMENTS; E. Weston, Newark, N. J. Application filed March 15, 1894. This comprises a scale plate of salient cross-section, a movable index and transverse arm on the index extending over the scale plate.